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DEVELOPMENT OF OPHTHALMOLOGY IN EUROPE*

PROF. E. FUCHS

VIENNA, AUSTRIA

The Wilmer Ophthalmic Institute is a worthy new member in the number of similar older institutions. Of these, the oldest and most famous is the Royal Ophthalmic Hospital in London—a hospital fortunate in the brilliancy of the men connected with it for many years, among whom the name of Bowman especially shines out with marked radiance; next comes the somewhat younger Gasthuis for Ooglijders in Utrecht, marked by the imperishable name of Snellen; the Foundation Rothschild in Paris; the Institutos Oftalmicos in Madrid and in Buenos Aires; and, last but not least, the Institute for Ophthalmic Research at Harvard founded by your countryman, the much regretted Dr. Lucian Howe, who did so much for the progress of our science in your country. The Wilmer Ophthalmic Institute will be able in time to surpass the older institutes, not only because of the great means at its disposal, but also because it can profit by the experience of the other institutions. The thoroughly good work that will go out from this institution in a scientific sense, and the humane work that will be done within its walls are guaranteed by the name of its director, Dr. Wilmer, who sacrificed a brilliant practice in order to devote himself to science and to the success of an institution for scientific investigations in his chosen field.

Ophthalmology was the first branch of the medical tree to split off from the parent stem and to become a specialty. This occurred in Egypt. About 1500 B. C., the Papyrus Ebers described a large number of specific cures and medicines for the diseases of the eye. The fame of Egyptian eye specialists extended over the entire world of that time, so much so that in 560 B. C., the Persian king, Cyrus, sent to Egypt for the best eye specialist.

It is easy to understand why ophthalmology should have been the first medical specialty, in spite of the fact that the eye is a relatively small organ, the loss of which, tragic as it is, does not involve a life risk. The function of the eye was understood by the most primitive of men, in contrast to the function of some much larger organs, which indeed has been discovered in recent years only. In the days of my medical studies the function of the thyroid was not known. This func-

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tion was discovered only when surgical asepsis made its removal possible and the consequences of it were observed. The opportunity of examining accurately the superficial aspects of the eye led to an early knowledge of many of its diseases, much more than was possible in other organs. This also allowed a greater therapeutic possibility, as the medicines could be applied directly to the affected organ and their effects observed. Operations were undertaken with more confidence on the eye than on other parts of the body, as severe hemorrhage, most

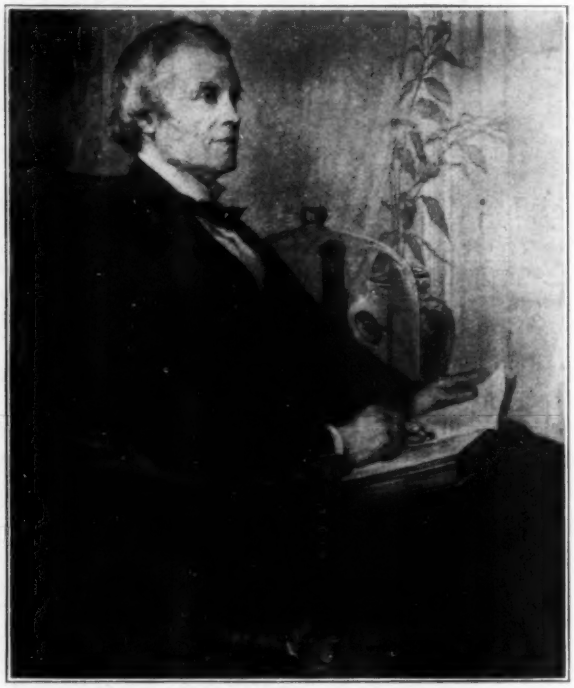

Fig. 1.—William Bowman—1816-1892.

dreaded by the surgeon of those days, was not encountered. The principal operation of all, that of cataract, performed by couching or pushing the opaque lens backward and downward into the vitreous body was followed by so striking a result, the immediate restoration of sight, that other ocular operations were freely performed. We are not surprised to find that Egypt is the ancient source from which the beginning knowledge of ocular diseases springs, or that there opthalmology first came into its own. Not only was Egypt the source of most ancient culture, but it was also the land most afflicted with diseases of the eye; reference to these conditions are found in the Bible. And this is true even today, in spite of the great efforts expended during the last decades toward the control, amelioration and final conquest of various ocular

diseases. Dr. MacCallam has been the guardian angel under whose activities an enormous amount of good has been accomplished; yet, in spite of this and of the fact that Egypt today possesses more special clinics and hospitals for diseases of the eye than any other country—twenty-three permanent and eight traveling hospitals—the percentage of trachoma among its inhabitants is still 92, according to the last report of the Department of Hygiene of the Egyptian Government.

Fig. 2.—Hermann Snellen—1834-1908.

The immediately favorable and in some cases at least permanently good result of the couching of cataract resulted in a specialty within a specialty, namely that of the coucher of cataracts. These persons knew nothing of medicine, but did possess, through skill handed down through family tradition and training and through their own practice, the ability to couch a cataract successfully. In India today such men still carry on their trade or profession, and it is not so long ago that this method of operating was still to be found in Europe. In 1914, I spent my summer vacation in the Tyrol. The physician of the village where I stayed, a man of 70, told me that in his youth he remembered

well seeing a coucher, who drove into the village in his carriage with his liveried servants, operate on the patients with cataract. I myself have operated on a coucher for a cataract, the man having for many years exerted his skill on his fellow countrymen in Turkey. Wenzel, in Paris, was a man of this ilk; a completely ignorant fellow who, however, obtained great skill in his method of operating, by practice on the highways of France, where he collected blind beggars and vagrants and

Fig. 3.—Patient prepared for operation.

relieved them of their cataracts. The blind person was seated on the ground, Wenzel stood behind him, clamped the patient's head between his knees and, bending himself forward, operated on the eye from above. His fame spread so that the Austrian Empress Maria Theresa sent for him, and in 1775, he operated on one of the ladies of her court. Wenzel was paid to spend some more time in Vienna to impart his knowledge to three young physicians, as no one in Vienna was acquainted with the technic of his proceedings. One of his pupils was Barth, who, besides teaching anatomy, was commissioned to teach ophthalmology also. It was Barth's pupil, Beer, who, in 1912, when ophthalmology became an

independent chair, was called to fill the post of professor. He had an independent clinic, with two wards, each of twelve beds. The students attended daily lectures for half a year, and in order to acquire the degree of Doctor of Medicine, had to pass an examination in ophthalmology. Slowly only did other countries and universities follow the example set by Vienna; even the famous von Graefe did not have a chair of his own until four years before his death; he was appointed

Fig. 4.—Couching of cataract.

professor of ophthalmology in 1866 and was the first incumbent, therefore, of the first German chair of ophthalmology. The University of Paris did not follow until 1879, when Panas took the chair. When I was called to the University of Liége in 1881, I was the first incumbent there. The first professors of ophthalmology in the United States were the Williams brothers, who had studied the subject in London, Paris and Vienna. The older, Henry Willard Williams, occupied the chair at Harvard University in 1871. The younger, Elkanah Williams, became professor of ophthalmology at Miami Medical College in Cincinnati in 1860; he especially brought to his colleagues in America the

knowledge and use of the ophthalmoscope. I knew him well personally; toward the end of the seventies he came to Vienna to see the work of Arlt, whose assistant I was at that time, and from then on up to his death in 1888, we kept in friendly touch by correspondence.

Ophthalmology, like other sciences, did not progress and develop in steady and uniform steps. A complete stagnation occurred after the fall of the Roman Empire. This was not relieved to any considerable extent by the then famous arabic oculists, who limited themselves to

Fig. 5.—Joseph Barth—1747-1818.

translating the works of the ancient authors, such as Hippocrates, Galenus and Celsus, with only poor additions of their own. The only progress in ophthalmology during the Middle Ages consisted in the invention of the spectacles, and that was not the work of an oculist but of scientists basing their work on Kepler's doctrines. The enormous modern development of ophthalmology has been the work of the last hundred years and is due to the invention of new methods of examination and modes of treatment, followed each time by a rapid progress in one field or another of ophthalmology. This is the usual way of development of any science, as can be well illustrated by one example, that of

bacteriology. Pasteur first recognized bacteria to be the cause of the process of putrefaction. Then it occurred to Koch to use solid mediums to grow the cultures on instead of the bouillon of Pasteur, and this new method only made it possible to isolate colonies of various types and identify them. But for this comparatively simple step in the technic, bacteriology today might still be the science of Pasteur's time. In ophthalmology the invention of the ophthalmoscope played a similar rôle.

Prior to the ophthalmoscope, an accurate examination of the eye was confined to the anterior segment, the source of illumination usually

Fig. 6.—Joseph Barth during his old age as a miser.

being ordinary daylight, and sometimes a magnifying glass was used to render small details sharper. Mackenzie, the Scotch surgeon, was the first to use a strong convex lens in order to concentrate the light rays on a limited part of the eye, to distinguish by means of this focal illumination details which had previously escaped observation. This principle of illumination has now been brought to a state of well nigh perfection by the development of the slit-lamp by Gullstrand. A new world for the ophthalmologist was opened by the invention of the ophthalmoscope by Helmholtz in 1851. On this again is built up the observation of the fundus of the eye by using as illumination red-free light, an invention of Vogt's. We are indebted to Helmholtz for another

precious aid in our work, that of the ophthalmometer, an instrument for measuring the curvature of the cornea which is now used in its practical form devised by Javal and Schiötz. Recent times have added valuable objective methods of examination, such as the skiascopy of Cuignet or the perfection of methods of ascertaining the ocular tension with the aid of the tonometer of Schiötz.

The method of correcting optical defects in a scientific way by means of properly fitted glasses, has been a relatively recent but impor-

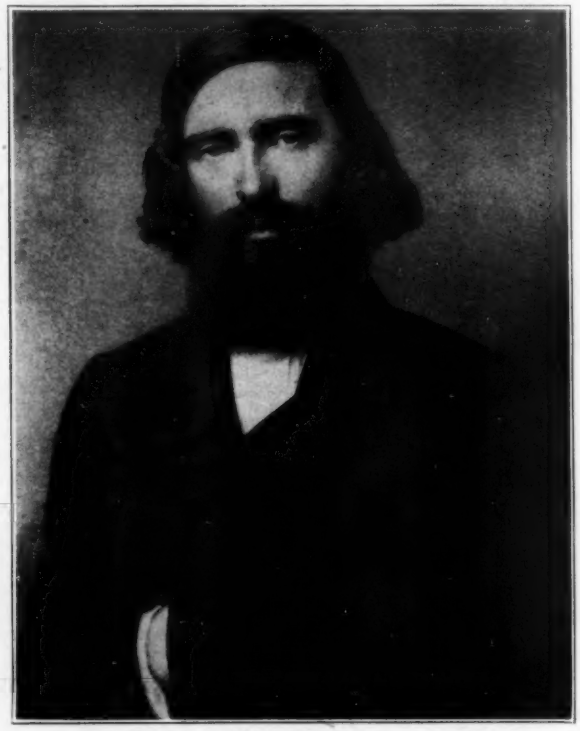

Fig. 7.—Albrecht von Graefe—1828-1870.

tant field for the ophthalmologist. Spectacles were in use for hundreds of years before they were fitted by specialists. As recently as the first half of the last century few oculists prescribed spectacles for a patient. A patient needing glasses at that time was told by his oculist that he was a physician and that his work was to cure diseases of the eye, not to fit glasses, and he was sent to an optician for this purpose. Oculists approached the correction of refraction with some understanding only after Donders had with such clarity elucidated the principles of refraction. He it was who first clearly defined the nature of hypermetropia, in 1858, and its relations to asthenopia and the clinical signifi-

cance of the latter. While physiologists had been long acquainted with the examination of the field of vision, it was not employed for diagnostic purposes in ocular diseases until the time of von Graefe. A beggar, who earned his living by his blindness, and was led about the streets, was discovered in the act of reading, picked up by the police as a cheat and brought to von Graefe. Von Graefe, by taking the field of vision, discovered that only central vision was present, and realized

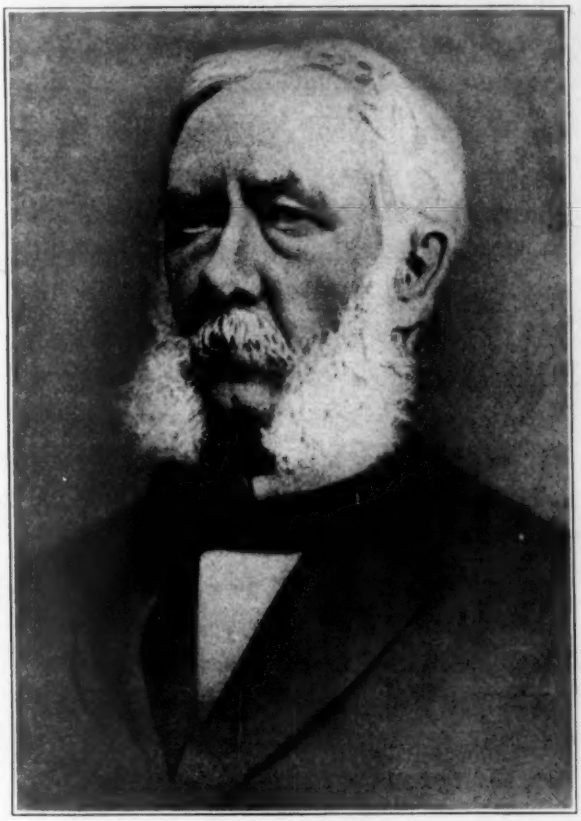

Fig. 8.—Henry W. Williams—1821-1895.

that peripheral vision also was necessary for proper orientation. The beggar suffered from retinitis pigmentosa, a disease in which central vision may still be good while peripheral vision is destroyed.

The operative field of our specialty has also not stood still; there the operations for cataract and glaucoma bear witness. The operation for cataract has undergone many improvements since Daviel, in 1746, substituted extraction of the lens for couching. Von Graefe's discovery, in 1857, of the cure of glaucoma by iridectomy has saved the sight of

innumerable sufferers. The introduction of antisepsis by Lister, with the later development of aseptic methods, rendered the ocular operations free from surgical infection. The next step to assure surgical success came about through the use of cocaine by Dr. Carl Koller, living among you now, who used it in Vienna, in 1884, for the first time; as a consequence of this, not only has cocaine robbed ocular

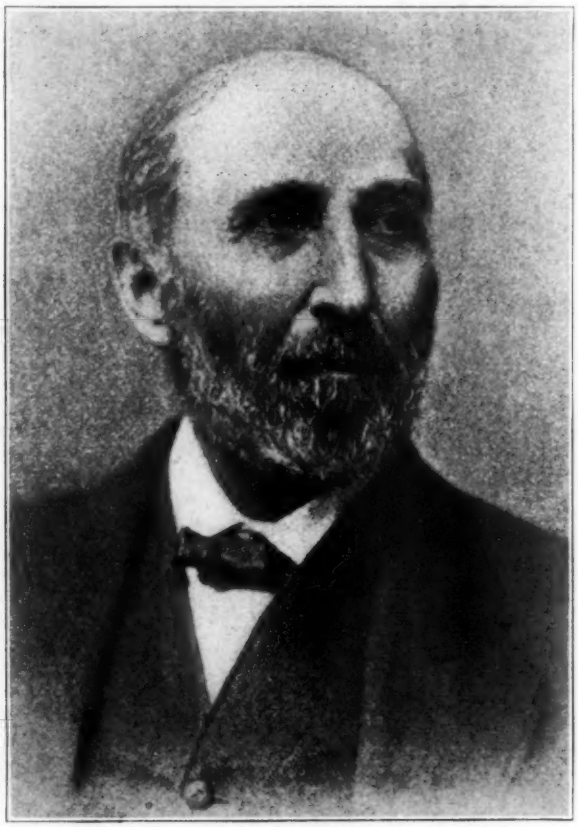

Fig. 9.—Elkanah Williams.

operations of pain, but it is used in many other beneficient ways in the practice of medicine and surgery. Those of us of some age have lived through the period of many of the advances in our science which I have mentioned. So in regard to cocaine I can better judge than most oculists the enormous advantage of its application in operations on the eye, as during the first twelve years of my professional career I had to perform operations without the use of cocaine and without a general anesthetic.

After the period of advance in diagnosis and treatment comes that of the prophylactic or preventive side of medicine, in the modern sense. In the old days this consisted only of isolating the sufferer after a diagnosis of the infectious character of his disease had been made; witness the isolation of the sufferer from smallpox, plague or leprosy. Folk lore or folk wisdom has occasionally struck the right note in prevention of disease; in China and Japan, for instance, tea since times immemorial replaces water as a drink, as the people realized the disease-

Fig. 10.—Hermann Helmholtz—1821-1894.

spreading possibilities of the drinking of unboiled polluted water. Most preventive methods used by the people were not intelligent ones, but were connected with belief in mysterious and potent agents, the wearing of amulets for turning aside the evil eye or the evil influence of ghosts and other similarly useless and supposedly magic contrivances or formulas. The effect of modern prophylactic methods is judged best by comparing the number of the blind in countries of low and high cultural level on one hand and by comparison of the blind formerly and at present in the same country. These figures are accurate only

since the time when the blind have been especially segregated in the count; the figures are too low, however, as all of the cases of blindness are never included; especially in countries in which the census is only by estimation we find the number of blind considerably higher than the estimate allows for. In 1899, there were on an average 8.7 blind in each 10,000 of population in the central and western European states;

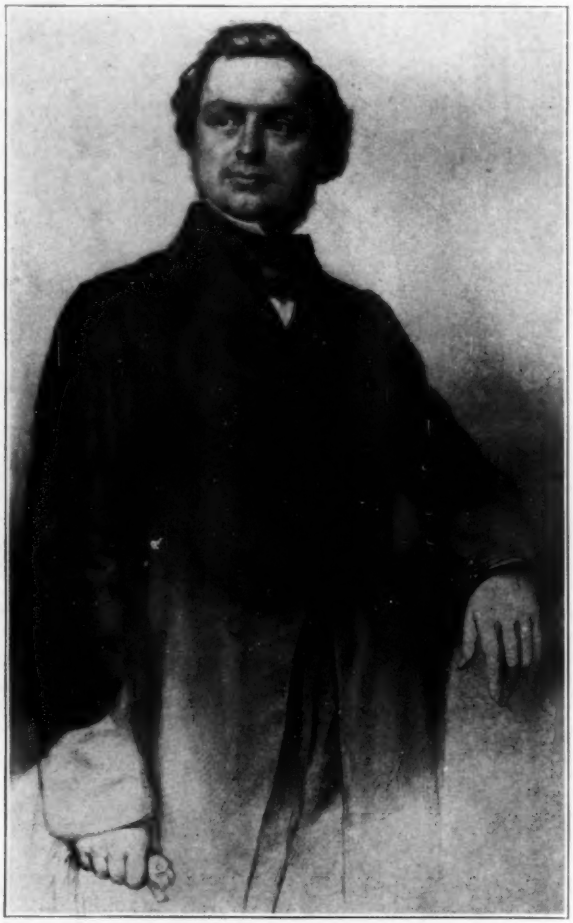

Fig. 11.—Frans Cornelis Donders—1818-1889.

in Russia approximately 20, and in Egypt as many as 132. Just before the world war, figures for the central and western European states were about two thirds of those in 1899—5.2 as against 8.7. The difference between then and now struck me forcibly in regard to Egypt. When I first visited there thirty-six years ago, it was a common experience to see blind beggars asking for alms, one holding the other's hand, a chain of four or five of them led by one who still possessed some sight.

And now one sees this no more. When I first visited the Arabic University of Al Azahr, in 1893, there were about 600 blind among the 4,000 students; at my last visit in 1926, I was told there were not more than 80.

We see what proper prophylactic measures can accomplish. The oldest is vaccination. Before the introduction of vaccination nearly everybody went through a light or severe attack of smallpox, and in a

Fig. 12.—Apotheosis of Jacques Daviel—1724-1816.

number of these cases the disease spread to the eyes, causing ulcers of the cornea and destruction of sight; the number of blind as a result of smallpox was great. In France about 35 per cent of all the blind lost their vision from smallpox; since vaccination has been in practice, cases of this sort scarcely occur.

In smallpox the prophylactic measures in regard to the protection of eyesight are not directed to the eyes themselves but against the under-

lying disease. The same is true regarding syphilis. With modern antisyphilitic therapy, the so frequent diseases of the eye secondary to the primary infection are prevented if treatment is applied early enough. The man himself is freed from external contagious lesions and is no more a danger to his fellow man. I do not abscribe it to greater continence of man, but to modern treatments, that syphilis is becoming less and less common, and I expect that, in civilized countries at least, it will in time be not more frequent than is today, for instance, leprosy; whereas in China and in Abyssinia, more than half of the population are syphilitic. The gonorrheal infection of the eye of the new-born is controlled by a prophylactic method applied directly to the eye. Between 7 and 21 per cent of all children in the obstetric wards used to be infected; of these a considerable portion lost vision, so that in the homes for the blind between 34 and 46 per cent of the patients had lost their sight due to infection at birth. Since the introduction of the preventive drop of silver nitrate by Credé the number of infections in obstetric hospitals has dropped to from 1 to 2 per cent, and of these few lose vision to a dangerous extent due to early and efficient treatment. Ocular infections from gonorrhea occurring outside of institutions are due to lax methods of applying the prophylaxis, or to lack of it, and are still more numerous than they should be.

I wish to speak of trachoma. The prophylactic battle is here a gigantic one. One sees this illustrated in Egypt. Immense efforts have been made, under most capable men with wisdom and foresight; yet the examination of school children according to the Department of Hygiene of the Egyptian Government shows the percentage infected in 1912 to have been 95 and in 1927, 92. Prophylaxis consists solely in protecting the healthy eye from the discharge of the afflicted eye, and this means personal hygiene and observation of the most scrupulous cleanliness, things rather difficult in a country in which water is as scarce as in Egypt. Cleanliness and personal hygiene are factors in folk culture present in greatest degree in countries in which culture is most advanced. There we find trachoma rarely and only among the poorer classes. Trachoma can then only be conquered slowly, as culture advances and the poor and dirty become less, and as economic conditions in afflicted countries become so that a cultural elevation of the people at large is possible.

As ophthalmology has developed, it has gradually lost its connections with general medicine to some extent. The efforts now and for the future are directed toward making this connection a closer one once more, for only certain diseases of the eye are of local origin; many others are dependent on constitutional defects of the patient, or are in connection with some general disorder or disease. In searching for

and elucidating the causal connection between disease of the eye and disease of the man, the leading rôle is being played by the United States.

In conclusion, no number of words could express the good wishes I bear for the success of the Wilmer Ophthalmic Institute, the opening of which we celebrate today. Truly America and Europe are looking on, and all have a right to expect good works from an undertaking so richly endowed and so happily started on its career.

A NEW ASTIGMATIC CHART *

T. H. ODENEAL, M.D.
BEVERLY, MASS.

I have used the astigmatic chart for several years, and it has given me such satisfaction that I wish to make it known. It is copied after the Verhoeff chart in that there is a movable circular dial impaled by a central brad to a square card.

On the square, as shown in the accompanying figure, the axes are marked and on the circle two lines at right angles to one another are drawn which are $\frac{1}{32}$ inch in diameter; it is the fineness of these lines that makes it reliable; the patient is never in doubt which line is the heavier. In the center of the circle a small square is drawn with lines $\frac{1}{64}$ inch in diameter. The patients' vision must be blurred at all times so that it is just barely possible for them to make out the 20/60 line on the Snellen chart; this may vary a line with some patients, but the 20/60 line will be found to meet most cases. After the vision is blurred (by overcorrection with spheres of whatever denomination is required), the patient is directed to look at the clock dial or at any one of the many similar charts (personally, I prefer the single line, as it is easier for the patient to pick out) and is requested to select the darkest line. The axis of this line is noted, one of the dials on my chart is turned to this axis and the patient's attention is directed to it; then it will be found that only one line can be seen (provided astigmatism is present), or if the astigmatism is very slight the opposite line can just be made out. By means of cylinders, a 0.25 diopter of opposite refractive denomination being used first (that is, a minus cylinder if a plus sphere is in the trial frame or vice versa), placed in front of the lens in the trial frame at right angles to the line or axis most distinctly seen, the cylinder that equalizes the two lines is found. When this cylinder is found the vision improves and it will be necessary to add a 0.50 diopter sphere (of the same denomination as that in the trial frame) in order to retain the fog, as it is necessary to cause this fogging at all times; to be certain that this is the case, the patient should look at the 20/60 line from time to time. If, with the vision fogged so that it is difficult for the patient to make out the 20/60 line, both lines on my chart appear alike, the astigmatism is fully corrected (the cylinders at the same time being in place) and the strength of the cylinder necessary to bring this about is the amount of astigmatism present (of the same denomination as that of the sphere in the trial frame), the

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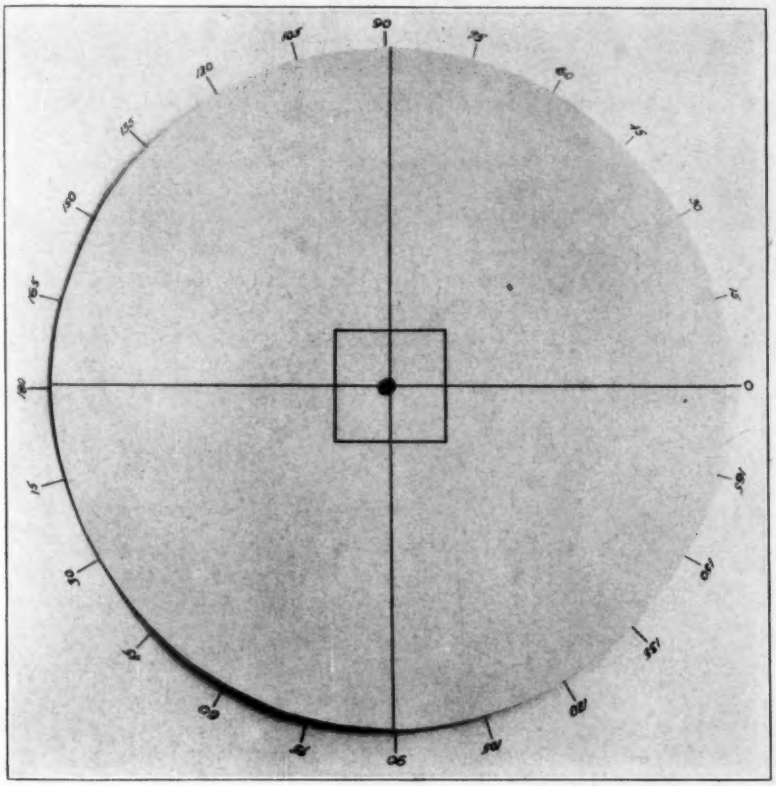
axis of which will be the same as that of the line which was most distinct before the cylinders were employed. By lessening the fogging by decreasing the strength of the spherical lens, the four sides of the small square in the center of the circle may be seen, which is further proof of the correction of the astigmatism. It is a common occurrence to have the patient indicate one of the lines on the dial chart as being heavier and then not be able to determine any difference in the lines on



A new astigmatic chart.

my chart, which shows the fallacy of employing the heavier lines for these charts. The answers are so often unsatisfactory with the present charts that many refractionists discard them altogether. It might be asked why not fog the heavier lines more, but this does not prove as satisfactory as only confusion exists when such heavy powered lens are employed, and also it is less confusing to have only two lines. For the latter reason I prefer first to employ the dial chart to determine the axis, and then to switch to my chart, rather than to have the chart composed of fine lines entirely and dialed. Rarely do I find the patient

confused with this chart, and correction to within 0.25 diopter of astigmatism is easily possible.

It is necessary to have the examining room at least three-fourths darkened and an evenly distributed light thrown on the charts.

I have not had a die made of this chart but V. Mueller's draftsman drew a few for me and might do so for any one interested.

EXENTERATION OF THE OCULAR CONTENTS BY A NEW TECHNIC*

RODERIC O'CONNOR, M.D.
OAKLAND, CALIF.

The advantages of the method proposed are as follows:

1. Entire absence of the puckered distortion of the globe such as occurs with either the horizontal or the vertical incisions.

2. Better motility of the artificial eye because of a better support afforded by the four ply thickening of the corneal overlaps.

3. Free access to the inside of the globe, making it much easier to remove the entire contents and to resect the optic nerve when desired.

4. While I have not tried it, I believe that this method of closing the eyeball would be much more likely to retain a small gold or glass globe.

5. Better cosmetic appearance with artificial eye, as there is less sinking of the upper lid.

6. No alteration in the lines of action of any of the recti, as the crucial incisions bisect the spaces between their insertions.

The steps in the operation are:

1. Make the usual circular separation of the conjunctiva.

2. Make crucial incisions of the cornea and sclera extending well back of the muscle insertions and bisecting the spaces between them.

3. Remove the ocular contents.

4. Wide separation of the four points with mosquito hemostats.

5. Remove any remnants of contents with gauze or curet.

6. Resect the optic nerve when desired; it is in plain view when head lamp illumination is used.

7. Curet corneal surfaces front and back in order to favor their quick union.

8. Place the mattress suture, as shown in figure 1, so that when tied the four points will be overlapped and held in close contact.

9. Purse-string suture of the conjunctiva over all. The usual dressing and after care are given.

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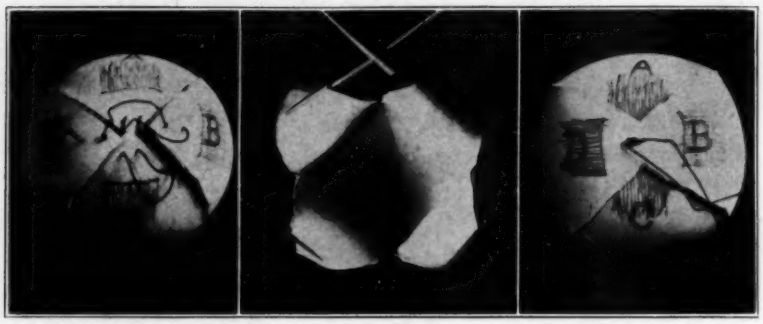

A B C

Fig. 1.—*A*, the lines of the crucial incisions and the appearance after placing, but before tightening, the mattress suture which is, of course, double-armed. *B*, the wide open appearance of the inside of the globe. *C*, the appearance after the suture is tightened and tied. (This illustration is more or less diagrammatic, as it is a photograph of the method as done on a hollow rubber ball.)

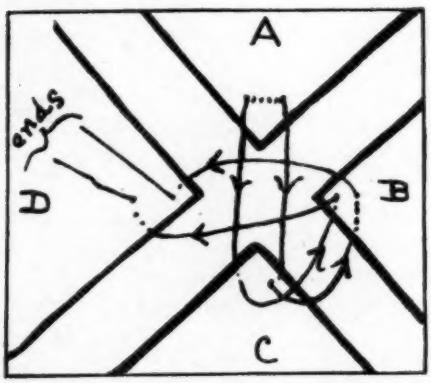

Fig. 2.—Diagrammatic representation of the course of the suture. It will be noted that in all four points the needles are passed from below.

AN INTERPRETATION OF DEFECTS IN THE VISUAL FIELD *

JOHN N. EVANS, M.D.
BROOKLYN

Interest in defects of the central part of the visual field was responsible for the studies in angioscotometry made in 1926 [1] and 1927,[2] and an effort to explain certain phenomena associated with these vessel shadows has resulted in the accumulation of evidence which seems to have important bearing on the interpretation of diverse pictures.

During recent years, certain anatomic and physiologic evidence has been presented which has not received the attention it deserves. Interest has been almost wholly concentrated on fiber bundles in the endeavor to account for this or that observation. In spite of the remarkable work of Igersheimer [3] and others,[4] knowledge of the arrangement, distribution and relations of the fiber bundles in the retina is but little more advanced than it was nearly forty years ago,[5] and there has been a satisfactory understanding of the mechanism of localized areas of retinal depression in but a small proportion of instances.

The neuro-anatomists and neurophysiologists, represented by such workers as Penfield,[6] Cajal,[7] Del Rio-Hortega [8] and Cone [9] on the one hand, and by Cushing,[10] Weed [11] and Wegefarth [12] on the other, have

* Submitted for publication, Oct. 29, 1929.

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10. Cushing, H.: Studies in Intracranial Physiology and Surgery, New York, Oxford University Press, 1926, pp. 1-51. Weed, L. H.: Theories of Drainage of Cerebrospinal Fluid with an Analysis of Methods of Investigation, J. M. Research **31**:21, 51 and 93, 1914.
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suggested repeatedly that ophthalmologists are overlooking evidence of utmost significance. Weed and Wegefarth [13] and others have been contributing studies to prove the detailed similarity of the mechanisms of the eye and brain; yet ophthalmologists have been dormant in their response to these researches.

Further proof of this neglect of the evidence at hand is shown by the fact that fragments are available in the literature of half a century. The evidence to be presented, on which interpretation rests, will be considered in three groups. The first originates in the newer knowledge of the retinal perivascular lymph space system; the second, in certain related material dealing with the anatomy and physiology of the blood vessel, and the third, with evidence derived from the study of the angioscotoma. A certain blending of these three sources is necessary, and the interspersion of material from the pathologic side facilitates the study.

The present understanding of the perivascular lymph system seems to have originated in the studies of His [14] and Schwalbe [15] on pressure injection. They state that they outlined the veins, and in places the arteries, with various dyes.

Such classic studies on ocular drainage as those of Deutschmann,[16] Priestley-Smith [17] and Gifford,[18] while advancing knowledge materially in certain respects, make but the barest indirect reference to the perivascular relations. Thus in Gifford's paper of 1892 [19] (p. 185), he merely stated that the phagocytic cells carried the india ink particles to various depths into the retina, but he made no reference to their relations to the retinal vessels. (He consistently found them about the vessels in the optic nerve of the rabbit's eye.)

The studies on lymph flow as taken up by each successive worker have, for the most part, made but slight advance over the previous stage. This has been due in part to the fact that each has repeated the earlier experiments in great detail, not only to gain facility in technic,

13. Weed, L., and Wegefarth, P.: The Analogous Processes of Cerebral and Ocular Fluids, J. M. Research **31**:167, 1914.

14. His, W.: Lymph Vessels of the Retina, Verhandl. der Natur. f. Gesellsch. in Basel **4**:24, 1865; Presentation on the Vascular System of the Retina in Man and in Rabbits, Arch. f. Anat. u. Physiol., 1880, p. 25.

15. Schwalbe, G. A. (Ludwig): Lymph Channels of the Retina and Vitreous Humor, Gesellsch. der Wissenschaft zu Leipzig, 1872, no. 24, p. 142; Studies on the Optic Nerve, in Hoffman's Anatomie, vol. 2, part 3.

16. Deutschmann, R.: Clinical and Experimental Contributions to Resorption of Pathological Contents of the Anterior Chamber, Arch. f. Ophth. **24**:12, 1878; The Sources of Aqueous Humor in the Eye, ibid. **26**:14, 1880.

17. Priestley-Smith: Glaucoma, London, 1879, p. 145.

18. Gifford, H.: Direction of the Lymph Streams in the Eye, Arch. Ophth. **15**:147, 1886.

19. Gifford, H.: Further Experiments on the Lymph Streams and Lymph Channels of the Eye, Arch. Ophth. **21**:171, 1892.

but also to check the previous studies. The tedious and laborious character of this work has carried each investigator to about the same point, and, though their conclusions vary greatly, the actual evidence has been uniform.

The conclusions of these workers differed, partly because different species of animals were used, and all were skeptical about the application of the evidence to the ocular conditions in man. With these same principles in mind, Noel and Benoit,[20] in 1900, presented what

Fig. 1.—Perivascular space delineation by the Weed-Wegefarth technic. A photomicrograph of a large artery and vein of the retina of an albino rabbit (unstained section). The prussian blue particles are seen in heavy clusters about the vessels. The artery cut in cross-sections clearly shows the nuclei of the endothelial lining. The granules are definitely not within the lumen. The vein, cut in oblique-longitudinal section, is slightly out of focus, but the restricted distribution of the particles is also evident. The prussian blue particles also bring out the vitreous framework.

20. Noel, J., and Benoit, F.: The Paths of Elimination of the Intra-ocular Fluid of the Anterior Chamber and the Back of the Eye, Arch. d'opht. **20**:11, 1900.

appears to be the most acceptable evidence up to that time. They found pigment about retinal vessels, but their technic required such severe trauma to the vitreous that their results can be accepted only with reserve.

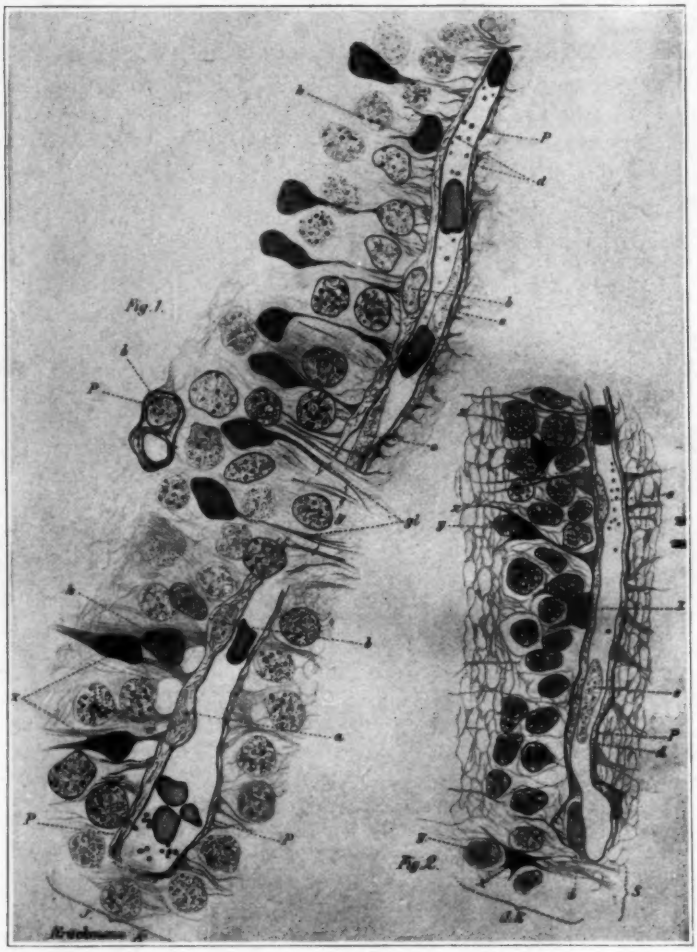

Fig. 2.—A photograph of Krückmann's plate (fig. 1 and 2) using his lettering: *P* indicates limitans perivascularis gliae; *E*, endothelial cells of the capillaries; *Z*, nucleated neuroglia feet; *D*, inner wall of the endothelial tube; *S*, visual cell layer (rod and cone); *B*, cells of the middle layer of the perivascular mesodermal lymphatic system; *X*, neuroglia cell connected with the perivascularis and *Y*, nerve cells (nuclei). This section represents a capillary loop directly below the optic nerve sheath.

Paterson [21] presented his review of the earlier work in 1904, but he made only meager reference to the retina, and none to the vessels, though his bibliography included the paper by Noel and Benoit.[20] He evidently did not assign great importance to posterior drainage.

In 1914, a collection of papers appeared under the title of "Studies on Cerebrospinal Fluid." [10] The introduction was written by Harvey Cushing and has a special value to ophthalmologists in that it makes evident, though indirectly, the great similarity of progress in the study of the lymphatic systems of the brain and eye. The second paper by Weed, while dealing primarily with a study of the flow of spinal fluid, is of more direct value, in that the methods of investigation used in

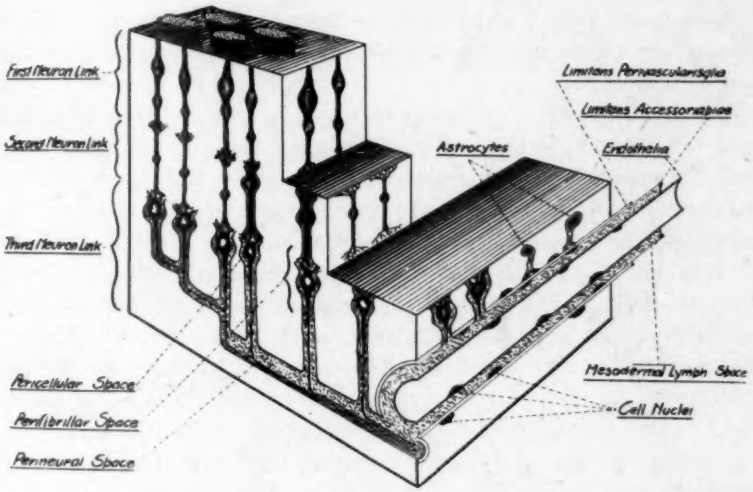

Fig. 3.—A diagrammatic representation of the retinal perivascular system.

working out the problems are discussed. Wegefarth undertook to follow the same methods in a study of ocular drainage. He first repeated much of the work of the older forms of experimentation with particulate stains, and, after discarding them, applied the technic used in the studies on the cerebrospinal fluid, using the prussian blue method.

The results of the work of Wegefarth,[12] while by far the most nearly satisfactory up to this time, must be carefully scrutinized before definite statements can be made. The Weed-Wegefarth method consists of injecting a slightly hypertonic solution of equal parts of potassium ferrocyanide and iron ammonium citrate into the vitreous. The animal is killed by bleeding after fifteen minutes, and the prussian blue particles are precipitated when the tissue is hardened in an acid solution of for-

21. Paterson, J. V.: Some Observations on the Lymph Flow Through the Eyeball in Man and Certain Animals, J. Path. & Bact. **9**:323, 1904.

maldehyde. This method gave me most satisfactory results,[22] and experiments on the eyes of more than 100 animals were performed: The outlining of extremely fine as well as large blood vessels was easily demonstrable. At no place could a single granule be found within the lining of a vessel; but, beyond the particles being clustered about the vessels, one could not state that they were in a formed space of any sort. Particles were also found clustered about the bipolar cells and their fibers and about the ganglion cells.

Magitot [23] has recently reiterated his opinion that the choroid, retina and iris are directly responsible for the production of the fluid.

In 1918, Professor Krűckmann [24] presented the results of a remarkable histologic study of the perivascular lymph spaces. After many efforts, he was able to prepare satisfactory sections of the retina, in which the details of the region were made evident by the special staining methods devised by Held.[25]

Pines [26] has recalled the dictum of Weigert—that blood vessels are mesodermal foreign bodies in the ectodermal tissue. In approaching the vessel, the neuroglia of the retina builds a tubular wall about it. This membrane Krűckmann called the glial mantle or glial sheath. The finer vessels (he discussed mainly the vessels of the inner granular layer) have relatively thin walls in which the endothelial lining represents the vessel. A delicate sheath is in contact with the vessel proper and is called by Krűckmann the accessory pial sheath. Between the glial sheath and the accessory pial sheath are weblike fibers; they are in the perivascular space proper. Each of these sheaths has within it its own cell nuclei. It will thus be seen that the perivascular space is a mesodermal lymph system walled off by a glial limiting membrane from the retinal elements proper.

A variety of cells that lie in juxtaposition to the small vessels has been demonstrated by the neuro-anatomists.[6] These cells have processes which terminate in foot plates, "sucker feet," and which join in the formation of the glial sheath. In the brain, it has been suggested that these cells probably have contractile powers. Krűckmann [24] identified many of these "astrocytes" in the retina and showed their relation to the perivascular spaces.

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22. It is proposed to present this study in detail at a later date.

23. Magitot, A.: The Multiple Sources of the Aqueous Humor, Arch. Ophth. **1**:139 (Jan.) 1929.

24. Krückmann, E.: Marginal Neuroglia and Perivascular Lymph Tract of the Retinal Capillaries, Ztschr. f. Augenh. **37**:125, 1918.

25. Held, H.: Marginal Neuroglia of the Human Cerebral Cortex, Monatschr. f. Psychiat. u. Neurol., 1909, p. 365, no. 26.

26. Pines, N.: Sclerosis of the Retinal Vessels, Brit. J. Ophth. **13**:160, 1929; ibid. **13**:225. 1929.

The vitreous body supplies certain evidence which has a more or less direct bearing on the posterior drainage problem. Recently numerous workers [27] have contributed to the knowledge of the structure and functions of the vitreous. Special mention should be made of Mann,[28] DeJean,[29] Redslob [30] and Cooper.[31] These writers made it evident that the folds and strands seen by the slit-lamp in the vitreous can be channel-like remnants of the fetal vitreous vessel system. It is possible that they function in adult life to transport accumulated fluid which the vitreous passes off or takes up. The vitreous, being a true jell, is capable of this water-regulating action under a great variety of physico-chemical influences.[32] It is probable that its aqueous element is drained off through the posterior channels. The relation of these canals to ocular drainage is discussed at length by Burdon Cooper.[31] Injection experiments show that when traumatism is minimized, little if any pigment passes forward.[33]

Reference to certain less directly related material of a purely physiologic nature is essential. The variations of intracranial and intra-ocular pressure [34] when hypertonic salt solutions are introduced into the systemic blood stream are significant. More noteworthy is the effect on these pressures following the compression of the jugular veins. The Quickenstead method [35] of studying cerebrospinal fluid pressure responses has come to be an accepted diagnostic procedure. Schoenberg's [36] recent

27. Lobeck, E.: Swelling of the Vitreous (An Abstract of Meeting), Arch. Ophth. **1**:295 (Feb.) 1929.

28. Mann, I. C.: The Nature and Boundaries of the Vitreous Humor, Tr. Ophth. Soc. U. Kingdom **47**:172, 1927.

29. DeJean, C.: The Canal of Cloquet, or The Central Canal of the Vitreous, Arch. d'Anat. d'Hist. et d'Embry. **5**:67, 1926.

30. Redslob, B. E.: Contribution to the Study of the Structure of the Vitreous, Ann. d'ocul. **164**:107, 1927.

31. Cooper, J. B.: The Permanent and Evanescent Canals of the Hyaloid, and Their Function in the Drainage of the Eye, Tr. Ophth. Soc. U. Kingdom **47**:341, 1927.

32. Duke-Elder, W. S., and Duke-Elder, P. M.: Some Physico-Chemical Factors Influencing the Intra-ocular Pressure, Brit. J. Ophth. **13**:385, 1929. Wagner, W., and Enderes, G.: Regarding the Dependence of Intra-ocular Pressure on the H-Ion Concentration of the Blood, Ztschr. f. Augenh. **64**:41, 1928.

33. Parsons, J. H.: The Pathology of the Eye, New York, G. P. Putnam's Sons, 1906, vol. 3, p. 993.

34. Lambert, R., and Wolff, J.: The Systemic Use of Hypertonic Solutions in Glaucoma, Arch. Ophth. **2**:198 (Aug. 2) 1929.

35. Stookey, B.: A Study of the Spinal Fluid Pressure in the Differential Diagnosis of Diseases of the Spinal Cord, Arch. Neurol. & Psychiat. **20**:84 (July) 1928. A Manometric Study of the Cerebrospinal Fluid in Suspected Spinal Cord Tumors, Surg. Gynec. Obst. **41**:429, 1925.

36. Schoenberg, M. J.: Remarks on the Artificial Induction of Ocular Hypertension by Compression of the Jugular Veins, Arch. Ophth. **1**:681, 691 (June 6) 1929.

contribution on the effects of jugular compression on intra-ocular tension not only carries the principle of the Quickenstead method into the field of ophthalmology, but presents new evidence of the utmost significance regarding factors in ocular drainage. The study advances materially the whole problem of venous-stasis mechanism, as it pertains to the interpretation of defects in the visual field.

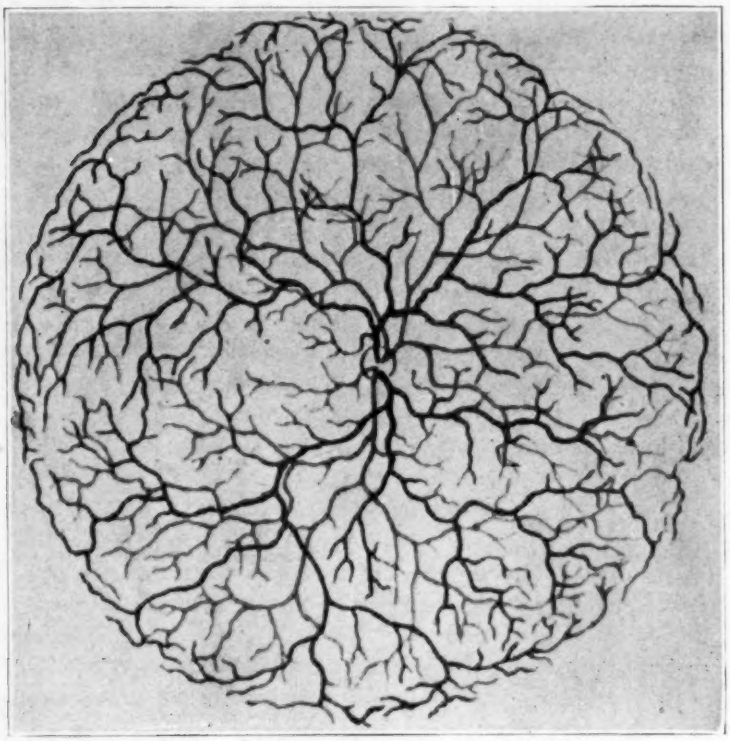

Fig. 4.—This figure is taken from Leber's chapter on circulation from the Graefe-Saemisch "Handbuch." It is after Langenbacher. It represents an injection preparation of the vascular network of the entire retina. It is inserted here to illustrate the wedgeshaped vascular units, which are built up by the dichotomous branching of the retinal vessel tree.

The ophthalmoscope has become so intimately affiliated with the clinical side of medicine that its value as an instrument of precision in the field of purely scientific study is apt to be underrated. Ophthalmoscopic evidence of the perivascular lymph space was probably the first step in developing interest in the subject. In everyday work, the flat whitish zone visible (in varying degrees in different subjects) as a

band on each side of the vessel has attracted attention.[37] This appearance corresponds to a "blood vessel-free" area, as demonstrated by Leber's [38] injection preparations. It seems reasonable, therefore, to conclude that this region is nourished by lymph from the adjacent vessels. Whether or not this lymph is in some definitely delimited channel, is not evident either from the injection specimens or from simple

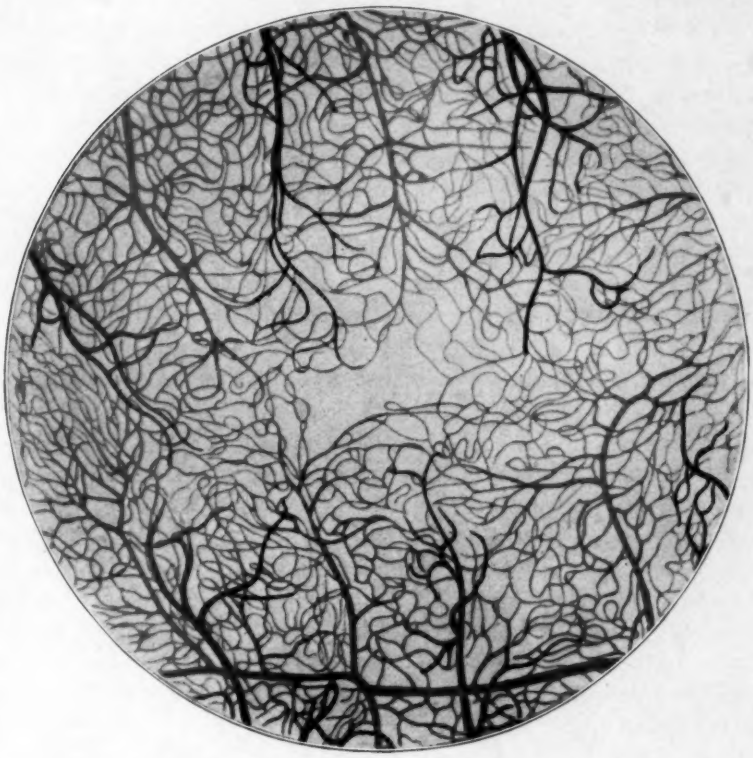

Fig. 5.—This figure is taken from Leber's chapter on circulation from the Graefe-Saemisch "Handbuch." It represents an injection preparation of the retinal blood vessels in the vicinity of the macula lutea. It was prepared by H. Muller. The palisade-like arrangement pointing toward the avascular center is of the utmost significance in interpreting the fingerlike scotomas found in the corresponding region of the visual field. It also helps to explain the ring scotoma of retinitis pigmentosa.

37. Parsons, J. H.: Diseases of the Eye, ed. 5, New York, The Macmillan Company, 1927, pp. 338-344. DeSchweinitz, G. E.: Diseases of the Eye, ed. 9, Philadelphia, W. B. Saunders Company, 1921, pp. 497-498.

38. Leber, T.: On the Ocular Circulation, in Graefe-Saemisch Handbook of Ophthalmology, ed. 2, vol. 2, part 2, p. 15. Parsons, J. H.: The Pathology of the Eye, New York, G. P. Putnam's Sons, 1906, vol. 3, pp. 953-954.

ophthalmoscopic observation. Nevertheless, Parsons [39] made the following definite statement: "There is an area on each side of the larger vessels which is free from capillaries. This is occupied in part by the perivascular lymph-sheaths."

That the sympathetic nervous system controls the caliber of vessels and the contractibility of astrocytes is not a new idea. Krough's [40] work on small vessels and the neuro-anatomists' work already cited must be kept in mind.

In certain pathologic conditions, not only is there ophthalmoscopic evidence of perivascular limitation of certain processes, but these observations can be corroborated by demonstration of the changes in microscopic preparations.

Among the ophthalmologic pictures, one would think of angioid streaks in the retina as a likely source of perivascular space delineation. Thus one finds of value a translation by Ward Holden of a paper by Rudolf Schilling.[41] It is a contribution to the pathogenesis of "Anomalies of the Vessel-like Formation of Streaks in the Retina." Schilling made the suggestion that these cases may be classed as: (1) perivascular, (2) circumvascular and (3) retrovascular. In the last group he placed: (a) retinitis striata (postinflammatory) and (b) striae retinae (after detachment).

If there were a few cases of each of these conditions with microscopic reports of the observations, many important points might be settled; but the few reports [42] available do not seem to represent the purely circumvascular type. Oatman [43] did consider that some forms might be due to pigment in the perivascular and other lymph spaces, but he was not inclined to accept the existence of such spaces from the studies then made. It is better therefore to refer only to those ophthalmologic pictures which have an established pathologic basis for the perivascular delineation, and on which satisfactory studies on the central visual field have been made.

Simple retinal hemorrhages—most characteristic—when slow in onset, sometimes seem to lie in channel-like restraint about the larger

39. Parsons, J. H.: The Pathology of the Eye, New York, G. P. Putnam's Sons, 1906, vol. 4, p. 958.

40. Krough, A.: The Anatomy and Physiology of Capillaries, New Haven, Yale University Press, 1924.

41. Schilling, R.: Streaks in the Retina, Arch. Ophth. **24**:235, 1903.

42. Hughes, W. I.: Angioid Streaks of the Fundus Oculi, Arch. Ophth. **1**:551 (May 5) 1929. Slocum, G.: Unique Case of Retinitis Striata, Jackson Birthday Volume, 1926, p. 210. Verhoeff, F. H.: The Nature and Pathogenesis of Angioid Streaks in the Ocular Fundus, Tr. Sect. Ophth., A. M. A., 1928, p. 243.

43. Oatman, E. L.: Diagnosis of the Fundus Oculi, Troy, N. Y., The Southworth Company, 1916, vol. 1, p. 214

vessels. Parsons [44] said that the blood is carried into this relation by the flow of lymph. When this blood organizes, the white bands of fibrous tissue accentuate the appearance.[45]

Low grade inflammatory processes are often characterized by a perivascular infiltration. The classic perivascular diseases, syphilis and tuberculosis, often give wonderful evidence of processes limited to the outer surface of the vessels.[46]

Pigmentary degeneration of the retina (retinitis pigmentosa) and also those forms of pigmentation of inflammatory origin which simulate the real degeneration have come to be accepted as classic forms of perivascular disease.[47] It is surprising how often cases in which there is a rise in pressure in retinitis pigmentosa are cited in the literature. In Shoemaker's [48] classic work on retinitis pigmentosa, he particularly stressed this point. He cited reports of many, and also other workers have emphasized it.[49]

The predilection of certain tumor cells to assume a perivascular position may also be presented.[50]

Certain poisons—most characteristic perhaps is that from quinine [51] —show a definite perivascular clinical picture and also microscopic evidence. Quinine poisoning should perhaps not be cited because of its infrequency.

The vascular conditions hardly need any comment, particularly when venous stasis is marked, for vascular disease of any sort is accepted as a predisposing factor in rise of tension, though the ultimate mechanism is seldom discussed.[52]

Among the degenerative changes, certain aspects of arteriosclerosis imply a toxic body, acting from the perivascular space and damaging the outer wall most. Such are, perhaps, the cases in which a white

44. Parsons, J. H.: The Pathology of the Eye, New York, G. P. Putnam's Sons, 1906, vol. 2, p. 571.

45. Igersheimer, J.; Steffan, R., and Fleischer: Periphlebitis, Am. Encyclo. Ophth. (Abstracts), vol. 12, p. 9610.

46. Schefft, O.: On Perivasculitis Retinae, Arch. f. Augenh. **24**:374, 1891.

47. Moore, F.: Medical Ophthalmology, ed. 2, Philadelphia, P. Blakiston's Son & Company, 1925, p. 64. Oatman, E. L.: Diagnosis of the Fundus Oculi, Troy, N. Y., The Southworth Company, 1916, vol. 1, p. 118.

48. Shoemaker, W. T.: Retinitis Pigmentosa, Philadelphia, J. B. Lippincott Company, 1909, p. 11.

49. Priestley-Smith: Glaucoma, London, 1879, p. 24.

50. Parsons, J. H.: The Pathology of the Eye, New York, G. P. Putnam's Sons, 1906, vol. 2, p. 505.

51. Elliott, R. H.: Quinine Poisoning, Its Ocular Lesions and Visual Disturbances, Am. J. Ophth. **1**:650, 1918.

52. Bailliart, P.: The Retinal Circulation, Chicago, Professional Press, 1928, p. 182.

fibrous cord appears to have replaced a vessel near the nerve head, but shows an active blood stream more peripherally.[53]

From the point of view of pathologic processes, one other bit of evidence should be inserted. In cases of increased intracranial pressure, particularly during the early stages, injection of the perivascular spaces about the nerve head is cited as a classic sign. The further point that venous stasis from diverse causes is associated with increased intracranial pressure, and that both these conditions are associated with ophthalmoscopic evidence of impeded blood outflow, should be considered.

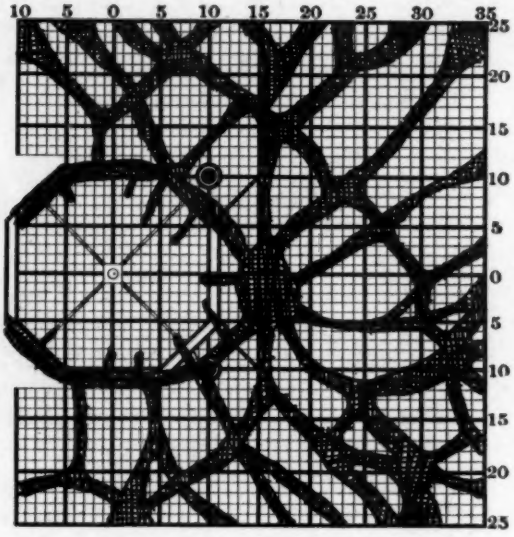

Fig. 6.—A typical vessel scotoma mapped with a 0.50 mm. white sphere at 190 mm.; 15 foot candles "artificial daylight" illumination.

The mere recitation of the conditions which assume this perivascular distribution would of itself be of little significance were it not for the accompanying manifestations associated with such processes which give evidence of another sort. If the conception as previously set forth is accepted, it must be expected that the flow of lymph from the deeper parts of the retina, from the vitreous and even from the anterior portions of the eye under certain conditions, will be retarded in its drainage by the posterior route, if the perivascular lymph spaces are obstructed. Obstructed outflow would then mean a stasis and rise of pressure within the perivascular system. This seems to signify that almost all, if not

53. Parsons (footnote 37, first reference). DeSchweinitz (footnote 37, second reference). Moore (footnote 47, first reference).

all, of the processes cited herein and characterized by changes in the perivascular region would be associated with increased intra-ocular pressure.[54]

As one reviews the literature for evidence bearing on the problem of the perivascular lymph space, isolated reports are occasionally encoun-

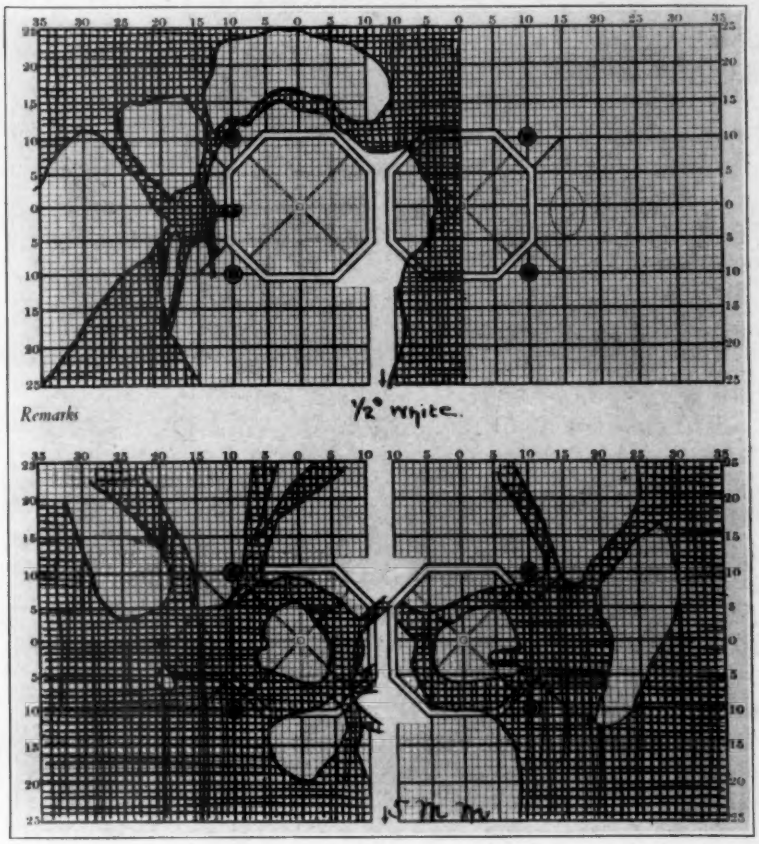

Fig. 7.—The upper figure represents a case of tuberculous perivasculitis—in the left eye; the lower figure represents what appeared to be a moderately advanced case of retinitis pigmentosa. The black represents the blind area.

tered which, though apparently positive, are nevertheless of such rarity as to be of but secondary value. Such, for instance, is the case reported

54. It is important to emphasize, however, that such rise would represent only an accumulation of fluid pressure above that which could escape through the anterior channels. The rise would at first be relative and local as far as the retina is concerned, but later would be an absolute and general pressure increase.

by Heyl,[55] under the title of "Rupture of Lymph Sheath of a Retinal Vein."

Even the master von Graefe [56] described in considerable detail defects that may now safely be interpreted as originating in vessel shadows; and Bjerrum,[57] in his classic paper of 1892, showed marked dissatisfaction with the explanations of fiber bundle compression as causing the crescentic enlargement of the blind spot. He called attention to certain conditions associated with vascular disease which simulate the glaucoma sign.

THE MECHANISM OF SCOTOMA PRODUCTION

Putting together these disjointed fragments, one may set forth the following conception of the posterior drainage mechanism as one basis for the interpretation of defects in the central part of the visual field.

One must begin the summary by recalling the neuron chain of retinal structure.

The first, a rod-cone link, forms a synapse with the outer filament of the bipolar cell, the inner filament of which forms a synapse with the ganglion cell. The axons of the ganglion cells build up the fiber bundles of the retina and pass uninterrupted to the primary centers in the brain. It will be remembered that the synapse is that organ in the neuron chain (McLeod [58]) which regulates the force of the transmitted nerve impulse. Strictly speaking, one should not use the word lymph, but the words tissue fluid. (McLeod [59] discussed the difference.) It has been seen, as in the brain, that the cells of the retina and their processes (with evidence lacking on the rods and cones) are surrounded by a fluid space; these are built up into a perineural space as the fibers of the cells form fiber bundles. The perineural spaces empty for the most part into the perivascular spaces which pass with the vessels through the optic nerve head into the body of the nerve. It is not clear whether or not the fluid from the perivascular space empties into the vaginal space, but the perivascular space probably follows the vessel through the membranes of the nerve so that the fluid is discharged into orbital channels. The significant features in this course are that the perivascular space is exposed to the inelastic resistance of the lamina cribosa and to the pressure variations of the spinal fluid in the vaginal space.

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55. Heyl, A. G.: Rupture of Lymph Sheath of a Retinal Vein, Tr. Am. Ophth. Soc. **7**:208, 1894.

56. Von Graefe, A.: Examination of the Field of Vision in Amblyopia, Arch. f. Ophth. **2**:258, 1856.

57. Bjerrum, J.: Clinical Groups of Glaucoma, The Scandinavian Ophth. Mag., 1892, vol. 5, p. 2.

58. McLeod, J.: Physiology and Biochemistry in Modern Medicine, ed. 5, St. Louis, C. V. Mosby Company, 1926, p. 150.

59. McLeod, J.: Physiology and Biochemistry in Modern Medicine, ed. 5, St. Louis, C. V. Mosby Company, 1926, p. 110.

Samojloff [59a] referred to the idea that the accumulated fluid of the perivascular system may press on adjoining tissue in glaucoma. He presented no evidence, however.

The fluid pressure within the perivascular drainage system would be dependent not only on the size of its own cross-section, but on the state of dilation of the enclosed vessel. Physiologically, a sudden dilation of a vein as in coughing, would be likely to cause a rise of pressure in the perivascular space and a back pressure into the retinal tissue. If this extended as far as a synapse, an interruption of its function would result in a loss of retinal response from the rod or cone of that neuron chain.[60] Blurred vision after a coughing spell or any form of venous-stasis may thus be explained. Strongly closing the eyelids, or pressure on the globe with the finger, would force fluid from the vitreous into the perivascular system, and again result in a suppression of synapse function. This is a common experience and is all the more noteworthy when it is recalled [61] that pressure on the globe causes a narrowing of the vessels and an associated contraction of the visual field. Narrow vessels should cast narrower shadows, but the angioscotoma actually widens. The perivascular space should also widen, however, and depression of the synapse due to back pressure in the perivascular space seems to explain the apparent paradox.

Strong light stimulation and consequent exhaustion of a localized retinal area should call for more tissue fluid to build up the exhausted cells. The astrocytes would then be called on to dilate the perivascular space, drawing more fluid from the vitreous. Such a change should be characterized by a drop in intra-ocular pressure, following light stimulation. A drop in intra-ocular pressure, due to light stimulation, has been repeatedly reported [62]—particularly in diseased eyes.[63] These pressure variations refer for the most part to changes too slight for the modern tonometer to detect.

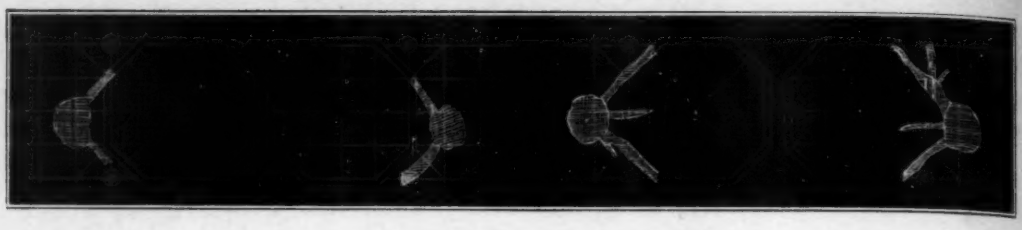
59a. Samojloff, A.: An Inquiry into the Changes Caused by Variation in Pressure in the Glaucoma Scotoma, Klin. Monatsbl. f. Augenh. **69**:67 (July-Dec.) 1922.

60. Susceptibility of the synapse is a neurologic truism, and weakness in this respect has been theoretically transferred to the more hardy fiber by those attempting to explain scotomas as originating by pressure on the fiber bundles.

61. Bailliart, P.: The Retinal Circulation, Chicago, Professional Press, 1928, pp. 27, 45 and 67.

62. Feigenbaum, D.: Influence of Light and Darkness Upon the Intra-ocular Pressure of Normal and of Glaucomatous Eyes, Klin. Monatsbl. f. Augenh. **80**: 678, 1928.

63. It must not be inferred that the reference to posterior drainage and increased intra-ocular pressure herein made are attempts to present a discussion of the theory of glaucoma. Such a question is far beyond the scope of this paper. Others writing on glaucoma theories have neglected consideration of the perivascular channels to an unwarranted degree, however.



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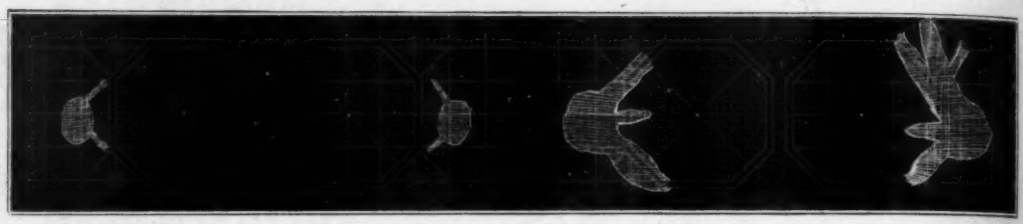
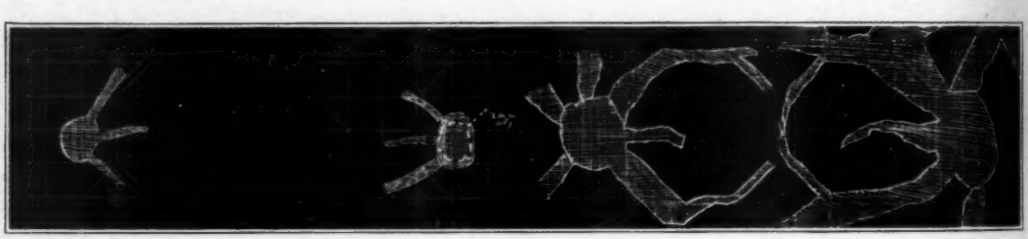


2 OSU = 4/6 OST = 28 Under 1/2% PILO for 1 week Aug 5 27 — ODU = 4/7 ODT = 28 1 mm obj

4 OSU - 4/6 - 3 OST - 22 No Pilo for 5 weeks Oct 6. 27 — ODU - 4/7-2 ODT - 27 1 mm obj

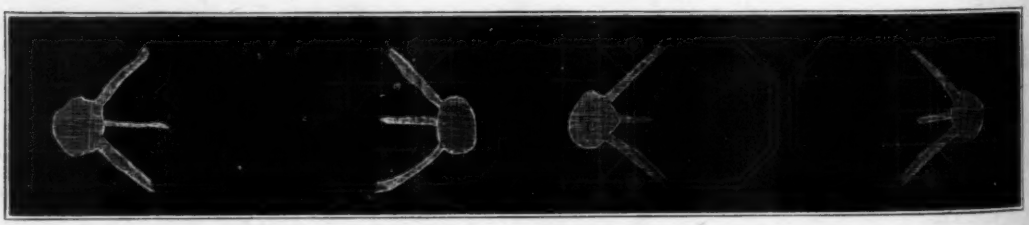
A

Fig. 8.—Maps 1 to 12 are from a case in which early glaucoma was suspected. The widening and narrowing of the vessel shadows corresponding to the periods when the patient was not using pilocarpine and when he was using pilocarpine are significant. The papillae were suspiciously "dishy." The symptoms — spells of morning blurred vision and "achy eyes" — were relieved by the drops. Could tonometric readings have been taken at frequent intervals, perhaps higher tensions would have been recorded. The angioscotoma seems more delicate as an index of glaucomatous changes than does any tonometer. McLean tonometer used. The white part represents the blind area.



5 O S U - 4/4 O S T - 22 Under Pilo for 5 days Oct 11 27 — O.D.U. 4/7 O.D.T. 19 1 M.M. Obj

7 OSU = 4/4 - 2 OST = 39 no Pilo for 2 weeks Jan 25 28 — ODU - 4/7-1 ODT - 32 1 MM obj



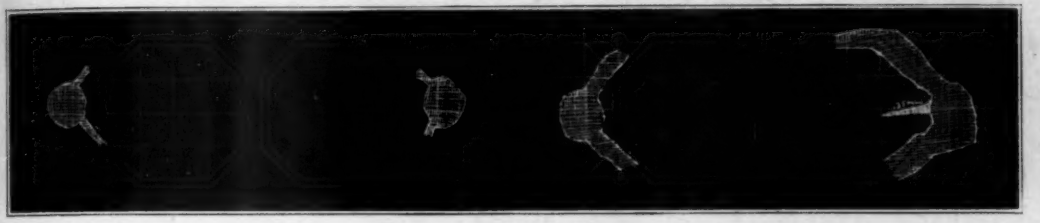
6 OS.U - 4/4 OS.T - 22 1/10 % Pilo. for 3 weeks Dec 17. 27 — O.D.U. 4/7 O.D.T. 22 1 mm obj

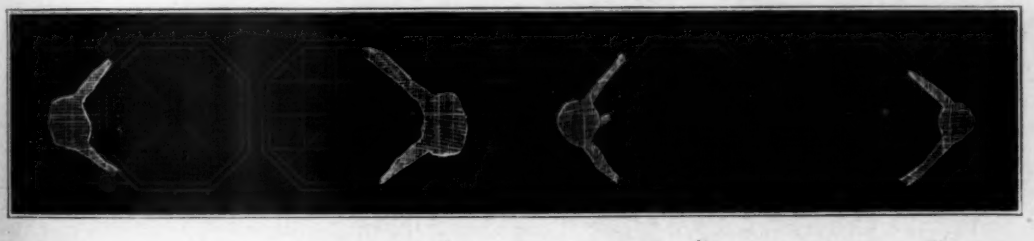
8 O.S.U - 4/4 O.S.T - 28 1/10 % Pilo 1/2 3 hrs for 3 days Jan 31 28 — O.D.U. - 4/6-2 O.D.T. - 28 1mm obj

B

Pathologic processes that obstruct the perivascular region from within the space, or from without, should also cause a back pressure into the retina with resultant loss of function at the synapse.[12]

Protracted loss of function would mean permanent damage, first, to the bipolar and ganglion cells from direct pressure, and from the action of the accumulated toxins; second, to the rods and cones from an "atrophy of disuse." It is interesting to note that in the perivascular diseases already mentioned, atrophy of the ganglion cells has often been cited as characteristic. The contractile powers of the astrocytes would also be impaired and a vicious cycle thus created.





C

The obstruction of the posterior drainage system at its point of outflow, due to increased intracranial pressure, should once again give rise to the same mechanism. In this case, however, venous distention soon obliterates the perivascular space where it passes through the resistant openings in the lamina cribrosa, and the effect is more localized in its manifestations—papilledema. The prepapillary membrane referred to by Parsons,[64] Krückmann[65] and Pines[66] would also figure in this

64. Parsons, J. H.: The Pathology of the Eye, New York, G. P. Putnam's Sons, 1906, vol. 2, p. 656.

65. Krückmann, E.: Marginal Neuroglia and Perivascular Lymph Tract of the Retinal Capillaries, Ztschr. f. Augenh. **37**:5, 1918.

66. Pines, H.: Sclerosis of the Retinal Vessels, Brit. J. Ophth. **13**:111, 1929.

peculiar localized picture. The mechanism of choked disk obviously involves many more factors than these.

The mere demonstration of the retinal vessel shadow as a plot-table scotoma has in itself little more than academic interest; but when it is recalled [67] that the angioscotoma showed widening under all the conditions cited, physiologic and pathologic, it is much more significant.

One should then expect a widening as a characteristic change in the angioscotoma as a sign of perivascular space disturbance.

In order to comprehend the syndrome of widening, one must visualize the entire retinal vessel system and add to it the perineural and pericellular lymph space conception as already set forth.

Injection preparations of the retinal vessels show that wedgeshaped systems of fine vessels unite to form zone after zone of wedgeshaped systems on account of the dichotomous method of division characterizing the retinal vessel tree. One should therefore expect to find evidence of increased activity of the perivascular space in a characteristic wedgeshaped area with its base toward the finer vascular divisions, and its apex toward the nerve head. This wedgeshaped area should be demonstrable by a corresponding characteristic defect in the visual field. Clinical studies give bountiful proof that this expectation is fulfilled with two exceptions. The area about the macula is not supplied by this wedgeshaped system, nor is the region immediately adjacent to the disk.

The macula is lacking in the more superficial retinal layers and is avascular, the perceptive elements getting their nourishment from the underlying choroid. Certain retinal vessels, however, approach the region of the macula and may even contribute indirectly through the tissue spaces to the nourishment of that highly important area. The characteristic distribution of these paramacular vessels is important in the interpretation of certain defects in the central part of the visual field.

Ophthalmoscopic study will reveal that from the upper and lower temporal quadrants of the nerve head an artery (or a branch of a larger vessel) arches outward and curves about the macula. Each sends innumerable fine finger-like branches pointing toward the macula, but fading in size to invisibility shortly after leaving the parent stem. These finer vessels are best studied by red-free light, entopically or anatomically by injection experiments. The larger curving vessels (superior and inferior macular arteries) are accompanied by veins. The veins lie peripherally to the arteries so that the small branches jutting from the veins and pointing toward the macula must cross the artery to reach the corresponding area.

Beside these relatively elaborate systems one or two small vessels pass out from the disk margin toward the macula (Parsons [68] said two

67. Evans (footnotes 1 and 2).

68. Parsons, J. H.: The Pathology of the Eye, New York, G. P. Putnam's Sons, 1906, vol. 4, p. 953.

arteries). They are placed slightly above or below the horizontal meridian. These vessels (horizontal macula) are visible out to about a disk head from the nerve edge. It should be remembered that the sickleshaped and the horizontal systems, to their smallest divisions, are accompanied by a perivascular space. In case of macular disease, one would expect an extension of the small finger-like vessels from all around—like the spokes of a wheel—and an extension of the horizontal vessels more centrally.

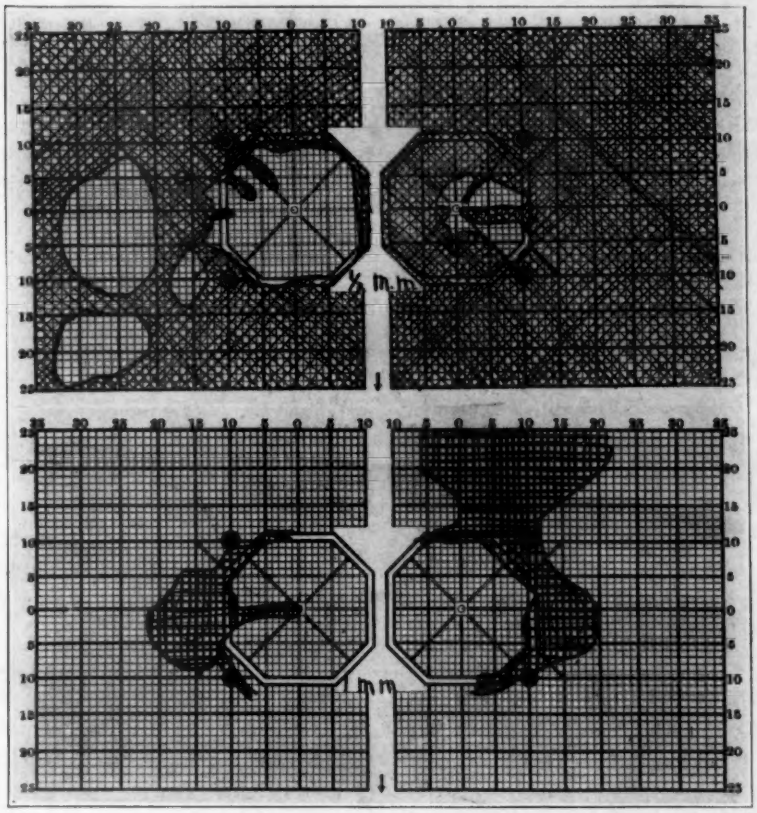


Fig. 9.—The upper figure represents the field of late glaucoma; the lower figure, a moderately advanced glaucoma. The black portion represents the blind area.

The retina adjacent to the nerve head is supplied by innumerable minute vascular twigs arising from the vascular circle of Zinn and reaching the retina in hooklike fashion and anastomosing with the capillaries of the retinal vessel system. Variations in these small vessels and their perivascular spaces may satisfactorily explain enlargement of the blind spot with increased intracranial pressure. It is possible

that lack of consideration of these inconspicuous vessels is responsible for much of the controversy between the two schools regarding arrangement of nerve fiber bundles. In order to gain a clear picture of this peripapillary blood supply, Leber's description from the second edition of the Graefe-Saemisch "Handbuch" [69] is worth quoting.

> The branches of the Zinn arterial corona and those extending from the choroid to the optic nerve run as follows: backward to the pia mater sheath in the vascular network of which they cross, so that this extends without break in the foramen sclerae to the end of the pia mater sheath; follow that closely to the part of the opticus enclosed in the Foramen sclerae and separately (besonders) to the neighborhood of the lamina cribrosa; separate on the vascularization of the papilla n. opt. and that of the adjoining part of the retina.
>
> Only fine branches of these vessels reach the retina itself and extend not at all or but slightly over the margin of the papilla and are not visible for microscopic examination. Sometimes, however, these offshoots of the ciliary vessels have larger caliber, extend into the retina and are available for ophthalmoscopic observation; they are then designated as cilioretinal vessels.

Krough,[40] in his work on capillaries, has pointed out that under certain conditions the small vessels close down in such a way as to skim off the serum and hold back the corpuscular elements, particularly where a branch is given off from a longer stem. Under heavy demands, these vessels open and allow whole blood to pass. The vascular palisade at the corneoscleral junction has long demonstrated this phenomenon to those interested in slit-lamp microscopy. It is reasonable to expect this in the retina. Such a vessel, even when full, might be invisible to the ophthalmoscope. The perivascular space of such a vessel would be active in proportion, as the vessel was active. We find that certain of the angioscotoma paths are longer and wider under light stimulation, etc., and can thus gain evidence of metabolic activity which cannot be demonstrated by other means.

The number of such fine branches increases as one goes farther from a parent stem, toward the periphery. If one conceives of an obstructed perivascular return flow with dilation of the entire perivascular tree, one would expect the periphery to show a blending of the smaller divisions because of their proximity to each other. This would depress the entire area of the periphery, and there would thus be a concentric contraction in proportion to the degree and duration of obstruction. The edge of such a contraction would be uneven or even serrated in outline.

Should the perivascular space be blocked by postinflammatory débris, the perivascular system of that area should alone show defective function through a characteristic wedgeshaped defect. The blending of a number of these should give rise to a sector or even quadrant defect.

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69. Leber, T.: On the Ocular Circulation, in Graefe-Saemisch Handbook of Ophthalmology, ed. 2, vol. 2, part 2, p. 8.

When there is obstruction at the exit through the nerve head, the amount of disturbance of the perivascular space will be proportionate to the rapidity of onset of the obstruction, the amount of vascular distention, and the rapidity with which the more peripheral perivascular spaces distend by the action of the astrocytes and transmitted pressure.

With disturbances of the sympathetic hormonal control of the astrocytes, disproportionate dilation of the perivascular space will become

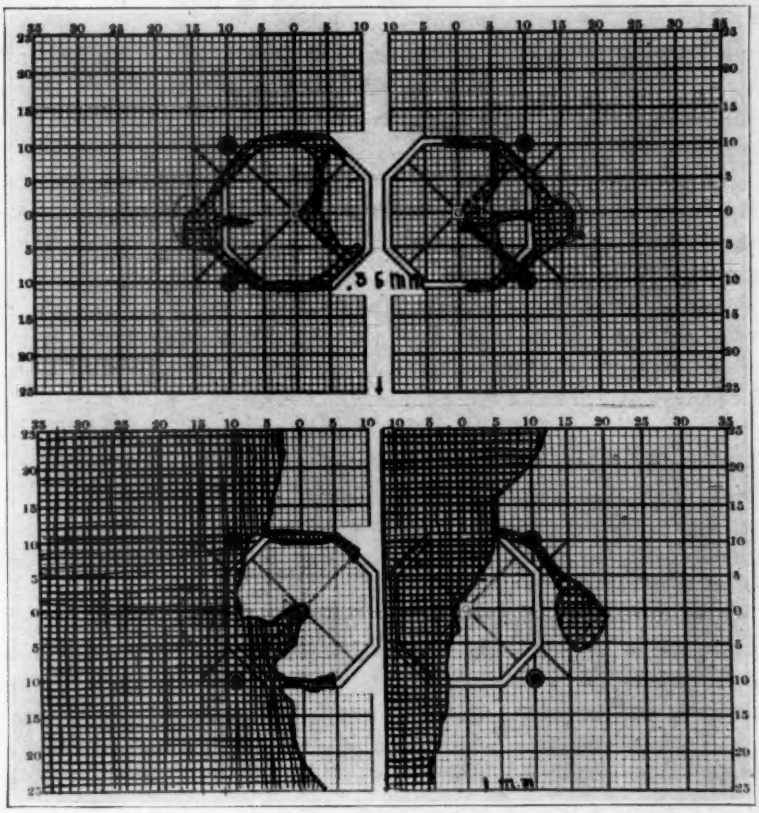

Fig. 10.—The upper figure represents the central region in a case showing a low-grade retinitis. By the usual methods of mapping, only a central scotoma would be located. The spokelike angioscotoma locates the defect and shows the effort at repair. The lower figure represents the field in a case of pituitary adenoma (verified at operation). The left homonomous hemianopsia being the result of a pure fiber bundle defect (having its origin high up in the pathway) does not affect the angioscotoma. The vessel shadows meet the fiber bundle defect at sharp angles. Increased intracranial pressure would have shown a widening of the vessel shadow.

evident. Such disturbances are possibly responsible for the onset of attacks of acute glaucoma through emotional upsets. One would then

expect to find earliest evidence of such an impending accident by study of the angioscotoma.

If all this evidence is acceptable, and if it is correct to interpret it in terms of angioscotoma variations, one should be able to demonstrate a great variety of allied conditions by studies on the central visual field which have this normal shadow as the starting place of pathologic deviations. It takes from one to two hours to make a moderately complete map of the larger angioscotomas for one eye, working with a persistent subject and an interested examiner. Such a clinical study would be not only impractical, but unnecessary. Familiarity with the retinal vessel tree as outlined will make it obvious that in some conditions it would be valuable to study certain branches, and in some conditions other branches.

The fact that it is known that sickleshaped blind spots occur in glaucoma, suggests that the two large shadows emerging from above and below the blind spot and arching about the macula be plotted. In toxic conditions characterized by central scotomas one would be inclined to follow the horizontal shadow running from the temporal side of the nerve toward the macula region. If this shadow is longer than 7 degrees, or if any angioscotoma is wider than would be expected (roughly 1 to 1½ degrees for the largest trunks), the case should be restudied at various intervals and the results checked by other types of study.

In the interpretation of the roentgenogram it is not enough to be familiar with the anatomy and physiology of the parts concerned; one must also adhere to the prescribed technic, or the results will be so distorted as to frustrate accurate interpretation. The same is equally true of studies on the visual field.

Without attempting at this time to review the details of a satisfactory technic, two principles will be referred to essential. First, a sufficiently minute object must be employed so that it will be entirely concealed when within the defect. (A ¼ degree object is most universally satisfactory as it is completely overlapped by the normal angioscotoma, the size varying slightly, however, for different subjects.) Second, it is necessary that the object approach the defect at right angles to its borders. Neither of these points are new or original in any sense; yet both are consistently ignored by the most interested workers, with the result that there has been a confusion of theories and a deluge of bizarre effects defying reasonable explanation.[70]

70. One other point seems of value. A lens placed before the eye to be examined, which will render the rays from the fixation point parallel, seems to make boundaries more definite. If the screen is at 330 mm. a +3 spherical lens before the eye would be indicated. Such a lens should be accurately corrected for oblique pencils and may be mounted in a reversible spectacle frame; the opposite cell contains a blinder for the eye and is not examined; the stereocampimeter is provided with lens and obturator and needs no such provision when used as a monocular instrument.

Assuming, then, a satisfactory technic, interpretation should be based on a comparison of pathologic and normal observations and an accurate diagnosis arrived at by consideration of corroborative evidence from other types of study.

The direct influence of the angioscotoma has been particularly stressed in its relation to the mechanism of central field defects; but it is well to keep in mind that when an area of retina is being damaged, the perivascular system is more active, and probably remains so as long as restoration to normal is incomplete. It is apparent for this reason that the angioscotoma is widened in cases showing a central scotoma. Instead of searching the central region for a scotoma, it is thus feasible to locate such a defect by following the vessel shadow to its source. The same pertains to more peripherally located blind areas. The angioscotoma in this sense may be said to have a secondary relation to the defect.

A third value of the angioscotoma is demonstrated in cases in which there is a known interruption of the fiber bundle conductivity—as by tumor pressure—along the optic pathway back of the eye. In such cases thus far studied, the angioscotoma meets the edge of the defect at a sharp, well defined angle—there is no blending of their outlines; the angioscotoma shows no widening. If increased intra-ocular pressure is now a superimposed factor, there is then stasis of the perivascular lymph and a widened map.

Had the angioscotoma no other value in a diagnostic sense, its study would still be justified, because it provides a topographic outline which not only helps in the localization of various processes, but also supplies a guide to show whether this or that area has been covered in a particular study. If one has succeeded in outlining a few vessel stumps about a blind spot, it is a guarantee that the blind spot has been carefully and reliably mapped.

It would be desirable to present a large number of charts with this paper, but their incorporation is not practical. More than six hundred [71] separate studies have been made during the past four years. As many as thirty maps have been made in following a single case. Many of the subjects were studied at frequent intervals over long periods of time. All the material has been derived from private practice, and was thus more fully worked up than had the work been done in the clinic. While many of the details remain for further elucidation, the uniformity of results is striking. It therefore seems reasonable to accept the perivascular lymph system in its relation to angioscotometry as a foundation on which to base the interpretation of a certain class of defects of the central part of the visual field.

23 Schermerhorn Street.

71. A study represents all work done on a single patient. Over 1,000 maps of various aspects of the angioscotoma have been made.

TATTOOING OF THE CORNEA WITH GOLD AND PLATINUM CHLORIDE *

DOHRMANN K. PISCHEL, M.D.
SAN FRANCISCO

Tattooing of the cornea is an old subject and as its history is well known, I will not go into details. Galen, in the second century after Christ, mentions tattooing of the cornea by means of copper sulphate, reduced with nutgall in the powdered form. DeWecker, in 1870, reintroduced it in its modern form, using india ink introduced into the cornea through mechanical means. Since then many other substances, including lamp black, candle black and many colored pigments, have been tried. Holth,[1] in an article published in 1926, gives an excellent report of the necessary technic and also gives glowing accounts of the results of his work with this method. In the hands of a master, such as Holth, this may be possible, but for the average man such achievements are out of the question. I believe I would be stating the truth if I said that most results have been disappointing, both to the patient and to the surgeon. A fine black pupil achieved with much effort and some pain becomes, in the course of a few days, woefully light again. Therefore, any improvement in technic or results must be welcomed.

GOLD CHLORIDE

Professor Knapp [2] of Basel presented in 1925 a method of chemically introducing a color into the cornea. This was the precipitation of the gold from a gold chloride solution into the corneal stroma. Since his first publication, many articles have appeared in the foreign literature reporting good results and describing modifications of his technic. In the American literature, however, this subject is mentioned only twice, once in a report of a successful case by Ellett [3] in 1926, and again in a paper by Gifford and Steinberg,[4] published in 1927. The latter gives an excellent review of all previous papers as well as a report of four successful cases.

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* Read before the Section on Ophthalmology at the Eightieth Annual Session of the American Medical Association, Portland, Ore., July 12, 1929.

* From the Division of Ophthalmology, Stanford University School of Medicine.

1. Holth, S.: Klin. Monatsbl. f. Augenh. **77**:289, 1926.

2. Knapp, P.: Klin. Monatsbl. f. Augenh. **75**:22, 693, 1925; **76**:609, 1926; **78**:212, 1927; **79**:433 (Oct. 28) 1927; **80**:378 (March 23) 1928.

3. Ellett, E. C.: Am. J. Ophth. **9**:771, 1926.

4. Gifford, S. R., and Steinberg, A.: Am. J. Ophth. **10**:240 (April) 1927.

Technic of Tattooing with Gold Chloride.—While the exact technic of using gold chloride has varied with different workers, a brief outline of the most generally practiced method is not out of place:

1. The cornea is anesthetized with cocaine or phenacaine, without epinephrine.

2. The area to be stained is outlined carefully with a large trephine or fine knife. The epithelium is thoroughly and evenly scraped off.

3. Hemorrhage is stopped without the use of epinephrine.

4. A cotton carrier, large enough to cover the part to be stained, is dipped in the faintly acid gold chloride 2 per cent solution, pressed out so as not to be dripping wet, and held against the denuded area. A fresh applicator is used every minute. After three minutes there will be a brown and after five minutes an almost black stain.

5. The reducing agent, epinephrine, or the more vigorous fresh 2 per cent tannic acid, is then dropped on the surface of the cornea for from one to two minutes; the eye is flushed with physiologic solution of sodium chloride, and is then bandaged.

Epinephrine must not be used during the anesthetizing, as it will reduce the gold chloride as soon as it is applied, and before it can penetrate into the corneal stroma.

The epithelium must be thoroughly and evenly scraped off. Some workers even recommend that some of the superficial stroma be removed to produce a stronger, darker stain. To achieve a gray instead of black the cornea may be stippled, the result being a large number of fine black spots which give a gray appearance against a light background.

The best results have been reported from the use of a 2 per cent gold chloride solution neutralized with sodium bicarbonate, so that it is just faintly acid to litmus paper. A too strongly acid solution causes undue irridation and vascularization, which is undesirable. The gold chloride does not need to be sterilized, as it is an antiseptic itself. Very dense and vascular leukomas may need a 3 per cent or possibly 5 per cent solution.

The question of what scars could or should be stained with this improved method fortunately can be answered. Any scar of the cornea, even thin staphylomas with iris inclusion, which under the old method of pigment and needle had to be left alone, can be readily and safely tattooed. By staining the maculae, dazzling can be reduced with great improvement of vision. There is little irritation afterward, and usually only a little pain for from twelve to twenty-four hours. The epithelium regenerates in four or five days.

Complications.—In the reports of several hundred successful cases by about a score of different investigators,[5] only three complications of

5. Pretori: Klin. Monatsbl. f. Augenh. **76**:700, 1926. Jilek: Ibid. **76**:833, 1926. Spanyol: Ibid. **76**:354, 1926. Rosenstein: Ibid. **77**:103, 1926. Shimkin: Ibid. **78**:375 (March) 1927. Braun, Georg: Ibid. **81**:72 (July) 1928.

a serious nature have been noted. In two [6] of the patients tattooing of a normal cornea had been done to cover a complicated white cataract in blind eyes. In both, the stroma was scarified after the epithelium had been removed. On the second day an hypopyon developed, without an infiltrate being present in the cornea. The hypopyon absorbed and all irritation ceased, with good result in the cornea, though the iris had a greenish yellow discoloration apparently due to penetration of gold chloride into the aqueous. In another case [7] there was the stirring up of an old iridocyclitis which ended well, but the result of the tattooing was nil.

Results.—The results are fairly gratifying. Fine maculae and normal corneas over complicated cataracts in blind eyes stain easily, and apparently the stain is quite lasting. In the course of from six to eight months it may fade a little. Vascular leukomas are more difficult to stain in the first place and fade more rapidly. This is due to the fact that the good circulation helps carry off the deposited gold, which is, of course, a foreign body. The colors obtained vary. An absolute black seems not to be possible. Dark brown and gray black, both of which appear fairly black at a short distance, are the best results, though not invariably obtained. Strict attention to the technic so as not to stir up irritation (e. g., avoiding too acid solutions, too deep scarification, or the use of epinephrine before application of the gold chloride) will result in deeper and more permanent colors. Conversely, if a light gray or brown is desired, some of these factors can be varied.

Tattooing in Albinos.—It was natural that a method which was so easy to employ would be suggested for tattooing the lids of albinos, in order to cut out the light. This was tried twice by Kreiker [8] and by Friedl,[9] both using the upper lids. In both cases a fine dark color developed, which did improve the vision temporarily. However, very severe reactions involving the cornea rapidly set in, and the superficial layer of the conjunctiva sloughed off, carrying the gold with it. Further experiments will have to be performed before this method is satisfactory.

PLATINUM CHLORIDE

In endeavoring to improve the gold chloride technic, Krautbauer [10] worked with other substances. He tried silver nitrate, as had Gifford

6. Photakis: Klin. Monatsbl. f. Augenh. **77**:690, 1926. Aust: Ztschr. f. Augenh. **58**:374.

7. Wiegmann: Klin. Monatsbl. f. Augenh. **81**:667, 1928.

8. Kreiker, A.: Klin. Monatsbl. f. Augenh. (Supplement) **77**:109 (Dec.) 1926.

9. Friedl, R.: Klin. Monatsbl. f. Augenh. (Supplement) **77**:113 (Dec.) 1926.

10. Krautbauer, G.: Klin. Monatsbl. f. Augenh. **80**:66 (Jan.) 1928; **80**:372 (March) 1928.

and Steinberg.[4] In 1928, he reported brilliant results with platinum chloride, hydrazine hydrate being used as the reducing agent. Knapp as well as Gifford had tried platinum without success, as they had not used this strong reducing agent. In Krautbauer's cases, an absolute dense black with a metallic luster was obtained, quite superior to the color resulting from the use of gold chloride.

Technic of Tattooing with Platinum.—The technic is similar to that for gold chloride but is somewhat simpler. No neutralization of the platinum solution is needed. On the other hand, the hydrazine hydrate must be fresh, never more than a week or ten days old. The concentrated solution of this substance keeps well, and from it the 2 per cent solution can be made up shortly before it is used. An outline of the technic follows:

1. The field is prepared (anesthetizing and scraping of the epithelium) as for gold chloride.
2. It is washed with sterile distilled water instead of salt solution.
3. Two per cent platinum chloride is then applied on an applicator as for the gold chloride, for two minutes.
4. It is reduced with hydrazine hydrate for twenty-five seconds, then washed promptly with sterile water. The color should appear promptly by this time.
5. Two minutes later the eye is washed well with physiologic solution of sodium chloride.
6. The eye is then bandaged.

The hydrazine hydrate is best applied from a dropper, a small drop being allowed to run onto the treated area and to rest there until washed off. This prevents any unnecessary irritation of the remainder of the cornea.

Too short a time has elapsed to indicate the permanence of the platinum as compared to the gold chloride, but apparently it is superior to that substance. Gold chloride reduced with hydrazine gives a darker color than when used in the older way, so this alone is a marked step forward in that method.

EXPERIMENTAL RESULTS

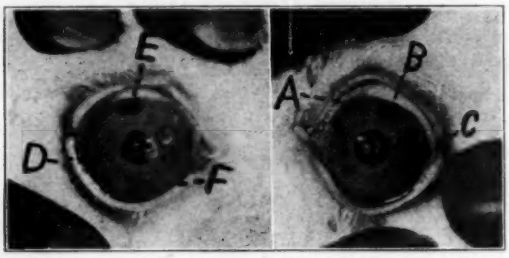
In my experimental work on rabbits I tried many different methods and different solutions, such as gold chloride, silver nitrate and finally platinum chloride. Except for the modification mentioned here, my final procedure followed the outline just given.

I believed that staining with fluorescein after I had scraped off the epithelium would enable me to determine whether the scraping had been done evenly. Accordingly, I added this step to the technic after step 2, and found it a great help, as it gave a clear picture of the area which had been scraped bare and which would therefore stain. The cornea

was then thoroughly washed with sterile distilled water before the next step was carried out.

Some workers have advised against the use of fluorescein, but in comparative tests I could not see any poorer results after its use than without it. In fact, better results were obtained with it, as is shown in the accompanying illustration, for I was able to scrape the epithelium off more evenly and obtained a smoother, evener stain, which lasted as long as that done without the fluorescein. I therefore recommend this added step in the technic.

Summary of Experimental Work.—Summing up the results of my experimental work, I found that the platinum chloride gave the blackest color and lasted the longest. Used after fluorescein it gave an evener color than without it, as may be seen if *B* and *C* are compared with *E* in the accompanying illustration. In the rabbits with normal corneas tattooed nine months ago, the stain has not faded at all. The gold



Eyes of albino rabbit showing results of tattooing: *A*, gold chloride, reduced with tannic acid (faint); *B* and *C*, fluorescein, platinum chloride, reduced with hydrazine hydrate (good, black); *D*, fluorescein, gold chloride, reduced with tannic acid (brown); *E*, platinum chloride, reduced with hydrazine hydrate (good, but irregular border); *F*, gold chloride, reduced with hydrazine hydrate (dark brown, but irregular border).

chloride reduced with hydrazine (*F*) faded only slightly, and could be used for dark brown. The gold chloride reduced with tannic acid faded considerably, that done without fluorescein more so than that done with it (*D* and *A*).

Practical Results.—I had the opportunity of using this method only twice on patients. The first had a large dense leukoma adherens, occupying the lower half of the cornea. The pupil was very small and displaced upward. The iris was dark brown. There was a pterygium-like area of conjunctiva drawn over onto the cornea from 4 o'clock for about 4 mm. This was removed by a McReynolds operation. Nine months later the white leukoma was tattooed with gold chloride, fluorescein being used to mark out the denuded area and tannic acid 2 per cent to reduce it. Three operations about ten days apart were neces-

sary to get the whole evenly stained a good brown. The reactions after each one were moderate, consisting of slight pain for about twelve hours, with some ciliary injection for forty-eight hours. The final step was the making of a black pupil. This was made a little too small for cosmetic purposes, but in the intervening six months it has not faded at all. The result has been very satisfactory to the patient.

The second patient also had a dense leukoma adherens, reaching up to the pupillary border (the result of smallpox). The iris was brown. As in the first case, this scar was tattooed in three stages with gold chloride and a good brown obtained. The postoperative reactions were the same. A black pupil was not put in because the patient's wife thought that his appearance had been improved so much that it was not necessary to do any more.

CONCLUSIONS

1. Tattooing the cornea with gold or platinum chloride is an effective means of coloring the cornea brown or black.

2. This method is much simpler and safer than the older methods.

3. The results of this method as far as permanence is concerned seem satisfactory, though a sufficiently long time for final judgment has not passed.

PERMEABILITY OF THE LENS CAPSULE

WITH SPECIAL REFERENCE TO THE ETIOLOGY OF SENILE CATARACT *

JONAS S. FRIEDENWALD, M.D.

BALTIMORE

Up to the end of the last century, the idea was widely held among ophthalmologists that the metabolism of the lens is insignificantly small. Interest in the physiology of the lens was therefore directed mainly to a consideration of its physical changes in accommodation. More recently, however, the chemical studies of Jess [1] and others have indicated that the lens has a definite protein metabolism, while experiments on the reduction of methylene blue [2] and on the consumption of dextrose and oxygen as measured by the Warburg apparatus [3] have shown that the lens possesses a small but definite carbohydrate metabolism. Since the lens is not supplied by blood vessels and is surrounded by a continuous membrane, the lens capsule, the degree of permeability of this membrane of necessity places certain limitations on the character and amount of the substances that can enter the lens as nutriments or that can leave the lens as products of its metabolism. The following study was therefore undertaken with the aim of discovering what substances could normally diffuse through the lens capsule, and also whether, within the range of normal senile change, sufficient alteration in the permeability of the lens capsule takes place to interfere seriously with the metabolic requirements of the lens, and thus cause senile cataract.

Extensive studies from a purely qualitative point of view performed by Hess [4] show that the lens capsule is normally permeable to all electrolytes and true solutes, and that it is permeable to some colloids, such as hemoglobin. These experiments were undertaken particularly to explain the resorption of the hypermature lens. I shall deal with this problem later. On the other hand, Löwenstein [5] recently advanced the hypothesis, unsupported by experiments, that the lens

* Submitted for publication, Sept. 25, 1929.

* From the Wilmer Ophthalmological Institute of the Johns Hopkins University and Hospital.

* Read in abstract at the Thirteenth International Ophthalmological Congress, Sept. 10, 1929.

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2. Ahlgren, G.: Acta Ophth. **5**:1, 1927.
3. Kronfeld, P.: Deutsch. Ophth. Gesellsch. **46**:230, 1927.
4. Hess, C.: Pathologie und Therapie des Linsensystems, in Graefe-Saemisch Handbuch, ed. 3, Leipzig, William Engelmann, 1911, pp. 35-49.
5. Löwenstein: Klin. Monatsbl. f. Augenh. **74**:786, 1925.

capsule is normally impermeable to the electrolytes of the aqueous, and that some forms of cataract are produced as a result of an injury to the lens capsule, increasing its permeability and allowing the electrolytes of the aqueous to gain admission to the lens. In view of this contradiction, it seemed worth while to review the whole subject de novo.

PORES IN THE LENS CAPSULE

Are there visible pores in the lens capsule? This problem was attacked by Hess, who was unable to demonstrate any pores in the capsule visible with the microscope. I have repeated his experiments and with the ultramicroscope have examined many specimens from various animal species, both fresh and stained with various dyes, and have failed to find any visible inhomogeneities in its structure. The pores of the lens capsule are, therefore, submicroscopic.

MEMBRANE CHARGE

Most biologic membranes which have been examined from the point of view of electrical charge have been found to possess an electrical charge in relation to fluids in which they are immersed. Such a charge exerts a marked influence on the permeability of the membrane, enhancing the permeability to ions and colloidal particles of opposite charge, and depressing the permeability to ions and colloidal particles of the same charge. Therefore, the experiment to be described was performed, with Dr. Arthur Grollman, to ascertain by the method of electro-endosmosis the nature of the charge on the lens capsule against physiologic sodium chloride solution (fig. 1). The principles involved in this experiment are given in many textbooks and will not be discussed here. It has been shown that if a semipermeable membrane is suspended in a solution against which it carries a negative charge, and an electrical potential difference is established across the membrane, then fluid will flow through the membrane from the positive to the negative side. If the membrane is positively charged then the flow is in the opposite direction. The experiment performed on the lens capsule revealed a flow of water, after allowing for the flow due to hydrostatic pressure, in the direction from the positive to the negative side. The lens capsule, therefore, possesses a negative charge in relation to physiologic sodium chloride solution.

QUALITATIVE STUDIES ON THE PERMEABILITY OF THE LENS CAPSULE

In testing the permeability of the lens capsule against a variety of substances, four procedures were adopted. In a number of instances, the substance to be tested was injected into the vitreous cavity of the eye of a living rabbit, and the lens was subsequently investigated for the presence of the substance, either by chemical tests or, when colored

substances were used, with the aid of the slit-lamp and the corneal microscope. In a second series of experiments, the same procedure was applied to freshly enucleated eyes of pigs. In a third series of experiments, the lenses were extracted from freshly enucleated eyes of pigs and immersed in a solution of the substance to be tested. In a fourth series, the lens capsules were removed, washed by repeated shaking in sodium chloride solution and tied onto glass tubes. A solution of the substance to be tested was then introduced into the inside of the tube, and the tube and attached capsule were immersed in sodium chloride solution in which the products of diffusion or filtration were collected. All four of these methods gave substantially the same results. It was necessary, however, in applying the last method to wash the capsules thoroughly, for it was found that the presence of small amounts

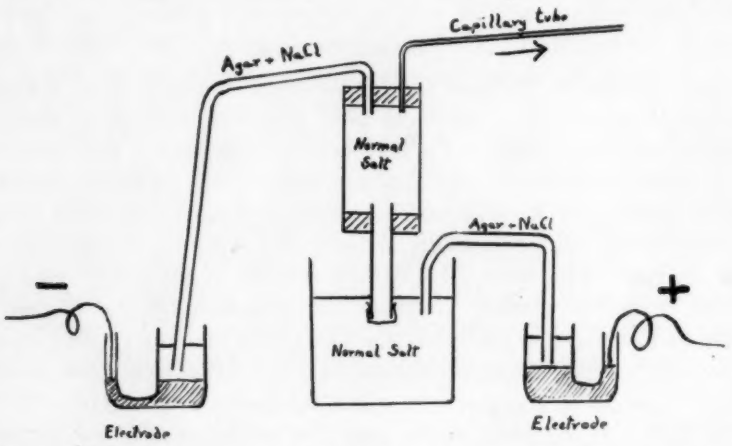

Fig. 1.—Technic for measuring membrane charge by electrical endosmosis.

of proteins from fragments of lens fibers adhering to the membrane markedly affected the permeability. On the other hand, thoroughly cleansed membranes can be kept in physiologic sodium chloride solution or in Ringer's solution in the ice box for days and even weeks without showing any change in their permeability. The permeability of the lens capsule is, qualitatively, the same in vitro as in vivo.

The results obtained from these experiments were entirely in accord with those of Hess. I append, therefore, table 1 in which the results of Hess are combined with my own, showing those substances for which the permeability of the lens capsule has been tested.

A consideration of the data given in this table leaves no room for doubt but that the lens capsule is permeable to all but the largest colloidal miscellae. As is to be expected from the negative charge which the membrane carries, it is slightly more permeable to electro-

positive colloids than to electronegative colloids. Among the substances tested, no evidence of anomalous permeability was discovered. As compared with other biologic membrane, the permeability of the lens capsule was found to be high, exceeding that of the capillaries which are normally impermeable to hemoglobin.

QUANTITATIVE STUDIES

Considerable difficulty was encountered in establishing a reliable method for the quantitative measurement of the permeability of the lens capsule. After repeated attempts, it was found impossible to make

TABLE 1.—*Permeability of Lens Capsule for Various Substances*

Substances Used in Tests	Permeability of Membrane
1. Electrolytes: Na^+, K^+, H^+, Ca^{++}; Cl^-, Br^-, I^-, SO_4^{--}, $Fe(CN)_6^{----}$	Freely permeable
2. Nonelectrolytes: Water, dextrose, sucrose, galactose	Freely permeable, the permeability decreasing with increasing molecular size
3. Dyes and Colloids	
A. Negatively Charged Particles	
Eosin—true solution, freely dissociated, moderately large molecules	++++
Tetrachlorphenolsulphonphthalein—true solution, feebly dissociated large molecule	++++
Rose Bengale—feebly dissociated, forms solution of small molecular aggregates at the boundary between true solution and colloidal solution	++++
Vital Red—true colloid, moderately large particles	++
Congo Red—true colloid, large particles	−
Colloidal Iron—true colloid, large particles	−
India Ink—suspensoid, microscopic and submicroscopic particles	−
B. Positively Charged Particles	
Methylene Blue—true solution, freely dissociated	++++
Gentian Violet—true colloid, moderately large particles	++++
Crystal Violet—true colloid, moderately large particles	++++
Erie Violet—true colloid, very large particles	++
Stilbene Blue—true colloid, very large particles	++
Night Blue—true colloid, very large particles	−
C. Proteins	
Hemoglobin—amphoteric substance but basic at the p_H of the experiment, very large particles, permeates membrane slowly when present in pure solution; does not permeate membrane in presence of serum	+
Egg Albumin—faint trace after diffusion for two days	Trace
Serum Globulin (horse)—no diffusion of globulin through the membrane, but a trace was found in filtrate formed under 1 meter water pressure	−

satisfactory measurements either in vivo or on the intact lens. The difficulty encountered consisted in the fact that measurable quantities of the test substance will enter the lens only if that substance is strongly adsorbed by the lens fibers, and for all substances tested the rate of adsorption was slower than the rate of diffusion through the membrane. It was therefore decided to measure the permeability of the capsule in vitro, the capsules being prepared and cleansed as outlined. For such measurements in vitro three methods are available: (*a*) Direct measurement of the amount of a given substance diffusing across a given area in a given time when a given concentration difference is maintained across the membrane. This method has two disadvantages. If highly diffusable substances are used, diffusion across the membrane

is so rapid that a film of relatively high concentration is developed on the side of lower concentration, and the initial concentration difference is reduced by an unknown amount. On the other hand, slight differences in the state of tension of one membrane as compared with the next would be expected to give differences in the readings by this method when those differences were of no physiologic significance. When the same membrane is used in several diffusion experiments to determine the effect of some extraneous factor, such as the presence of proteins, this method can be used, especially if a fairly large colloid is used as the test substance.

(*b*) The second method of measuring permeability is the potentiometric method of Michaelis and Fujita,[6] which has been widely used in biologic experimentation. This method consists in placing on either side of the membrane solutions of potassium chloride of different concentration. This salt is used because the velocities of diffusion of K^+ and Cl^- in water are nearly equal. If the membrane is more permeable to one or the other of these ions, an electrical potential difference is established across the membrane, the degree of potential being roughly proportional to the impermeability. The membrane in question, however, is so highly permeable that zero readings are obtained by this method.

(*c*) A third method, the one that was adopted for most of the experiments to be reported was suggested by the experiments of Fujita.[7] It consists in comparing the absolute permeability of the membrane to two substances, one highly diffusible, one poorly diffusible. In the absence of anomalous osmosis, a change in the permeability of the membrane will have a much greater effect on the rate of diffusion of the poorly diffusing substance than on that of the more rapidly diffusing substance. The technic of the experiment is simple. The membrane to be studied is fastened on the end of a small glass tube and immersed in physiologic sodium chloride solution. A solution of the two test substances in known proportions, in physiologic sodium chloride solution, is introduced into the inside of the glass tube. After an appropriate interval, the concentration of the two substances in the diffusate is measured and the ratio

$$\frac{\frac{A}{B}\ \text{diffusate}}{\frac{A}{B}\ \text{original solution}}$$

is taken as a measure of the permeability of the membrane.

6. Michaelis, L., and Fujita, A.: Biochem. Ztschr. **161**:47; **164**:23, 1925.
7. Fujita, A.: Biochem, Ztschr. **170**:18, 1926.

After much experimentation, the substances chosen for this purpose were tetrachlorphenolsulphonphthalein and vital red. These substances were chosen because their characteristics in solution are well known. The former, though possessing an extremely large molecule, forms a true solution in water. The latter forms a colloidal solution in which the micellae are remarkably constant in size. Both are electronegative. Slight changes in the membrane charge due to slight unavoidable changes in the p_H of the solution would not, therefore, be expected to alter the diffusion ratio. As a matter of fact, good checks were obtained in applying this method on the same membrane repeatedly. Also, within limits, the time of diffusion was not found to affect the diffusion ratio. The experiments could, therefore, be allowed to progress until measureable quantities of the dyes appeared in the diffusate. The relative concentrations of the dyes were then measured spectrometrically. This could be done the more readily because tetra-

TABLE 2.—*Effect of Various Substances on Permeability of Lens Capsule*

Substance Affecting Permeability	Diffusing Substance	Result
$CaCl_2$	Gentian violet	Marked reduction in permeability
KCN	Vital red	Marked reduction in permeability
KCl	Vital red	No effect
Egg albumin	Gentian violet	Marked reduction in permeability
Blood serum	Hemoglobin	Permeability abolished

chlorphenolsulphonphthalein has a strong absorption band in the red where vital red transmits freely, and, on the other hand, transmits freely in the blue where vital red absorbs strongly.

SUBSTANCES CAUSING A DECREASE IN THE PERMEABILITY OF THE LENS CAPSULE

In these experiments the method described under (*a*) was used. All solutions were made up in physiologic sodium chloride solution or in Ringer's solution. The membrane to be tested was fastened on the end of a glass tube, a solution of the diffusing substance was introduced inside the tube and the membrane was immersed in a small volume of fluid in which the diffusate was collected. After a given time, the concentration of the test substance in the diffusate was measured. The experiment was then set up again with fresh fluid for the diffusate, and the substance the effect of which on permeability was to be determined was introduced in equal concentration on both sides of the membrane. After the same period of diffusion, the concentration of the test substance in the diffusate was again measured. The results of these experiments are given in table 2.

COMPARISON OF THE PERMEABILITY OF LENS CAPSULES OBTAINED FROM DIFFERENT INDIVIDUALS

The method described under (*c*) was used to measure the permeability of the membranes. The results are shown in figure 2 and table 3.

The analysis of these results presents many points of interest. In the first place, it may be seen, in comparing the figures for adult noncataractous lenses from different species, that the individual variations are considerable but that the averages for different species do not vary significantly, as is shown in table 4. This fact is all the more remarkable because there is considerable difference in the thickness of the lens capsules derived from different species, the cow's lens capsule being several times as thick as the pig's.

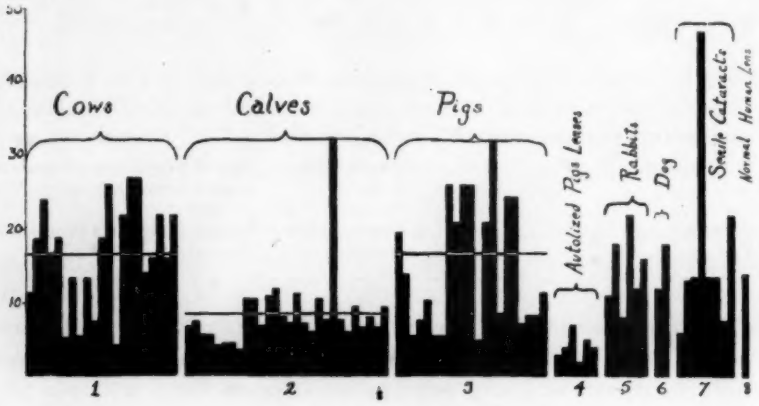

Fig. 2.—Diffusion ratio $\frac{\text{Tetrachlorphenolsulphonphthalein}}{\text{Vital Red}}$ for various lens capsules: (1) cows, (2) calves, (3) pigs, (4) autolyzed lenses of pigs, (5) rabbits, (6) dogs, (7) senile cataracts, (8) normal human lens.

CHANGE IN PERMEABILITY WITH AGE

A comparison of the figures for cows and calves shows that, with the exception of one aberrant reading which may have been due to an experimental error, the permeability of calves' capsules is much less subject to individual variation than that of cows' capsules. The statistical analysis of these data is shown in table 5. These figures indicate a high degree of certainty that the differences found between the permeabilities of capsules from calves and adult cows is significant and not due to the effects of random sampling. In fact, if the one aberrant result in the readings on calves capsules is eliminated, namely, that in

which the diffusion ratio was 32 and in which I suspected an experimental error, then the certainty of a significant difference in the figures becomes absolute. In figures, the probability that the difference observed, with this reading eliminated, should be due to random sampling is 0.000005. One may conclude, then, that in cows there is a significant decrease in the permeability of the lens capsule with age.

TABLE 3.—*Diffusion Ratio Tetrachlorphenolsulphonphthalein for Various Lens Capsules Vital Red*

Cows	Calves	Pigs	Human Normal Lens	Cataracts
18.7	6.8	19.6		6.0
11.3	7.5	14	14	13.1
24	5.7	5.7		13.6
16.4	5.7	7.7		13.6
18.8	4.2	10.3		13.6
5.1	4.5	5.7	Dogs	7.7
13.4	4.6	5.7		47.0
5.5	3.7	26	12	22.0
13.4	10.6	21	18	
7.4	10.6	26		
18.8	7	26		
26	11	5		Autolized Lenses of Pigs
4.3	12	21	Rabbits	
22	8.1	32		
27	7.3	8.5	11	3
27	11.3	24.3	18	4
14	7.3	24.3	8	7
16	6.1	7.2	22	2
22	10.6	8.3	12	5
10	7.7	8.3	6	4
22	32	11.4		
	7.7			
Average 16.5	6.1	Average 16.7		
	9.5			
	6.7			
	8.1			
	6.7			
	9.5			
	Average 8.6			

TABLE 4.—*Diffusion Ratio Tetrachlorphenolsulphonphthalein for Different Species Vital Red*

Species	Number Tested	Mean
Cow	21	16.5
Pig	21	16.7
Rabbit	6	12.9
Dog	2	14
Man	1	14

THE PERMEABILITY OF CAPSULES OF CATARACTOUS LENSES

The readings on capsules from cataractous lenses fall approximately within the limits of individual variation in normal adults. In order to interpret these observations, it becomes necessary first to discover whether the presence of cataractous lens substance itself exerts any influence on the permeability of the lens capsule. Lenses were therefore removed aseptically from the pigs' eyes immediately after death and placed in sterile physiologic sodium chloride solution in the incubator. Free access of oxygen was supplied, but no nutritional substances were

added, nor were the products of the metabolism of the lenses removed. In the course of two or three days, cortical opacities were found to develop, and by the end of one week the lenses presented the appearance of mature cortical cataracts. The capsules were then removed and washed free from cortex by repeated shakings in physiologic sodium chloride solution, and their permeability was measured by the usual method. The results of these experiments (fig. 2 and table 3) show a marked increase in the permeability of lens capsules which have been exposed to cataractous lens cortex. The capsules of cataractous lenses had also been exposed to the action of autolyzed lens cortex prior to their removal from the eye. Comparing the figures for the permeability of the capsules of lenses showing spontaneous cataract with that of the capsules of lenses autolyzed in vitro, I find that the former are much less permeable than the latter. In view of the effect of autolyzed

TABLE 5.—*Comparison of the Diffusion Ratio Tetrachlorphenolsulphonphthalein for Cows and Calves Vital Red*

	Number	Mean	Standard Deviation	Prabable Error of Mean
	N		0	$P.E. = 0\frac{0.6745}{N}$
Cows	21	16.5	7.0	± 1.3
Calves	28	8.6	5.0	± 0.64

(a) Difference of means, 8.0

(b) Probable error of difference $= \frac{^2}{PE_1} + \frac{^2}{PE_2} \pm 1.76$

(c) $\frac{\text{Difference}}{\text{P.E. of Difference}}$ 4.5

(d) Probability that this difference would occur as the result of random sampling, 0.0021

lens cortex on the permeability of the capsule, I have, to the present, not been able to determine directly the status in regard to the permeability of the lens capsule during the incipience of cataract. The inference can, however, be drawn from my experiments that the permeability at that time is probably very low.

The discovery that the presence of autolyzed lens cortex greatly increases the permeability of the lens capsule aids us in understanding the mechanism of the resorption of hypermature cataracts.

CAN A DECREASE IN THE PERMEABILITY OF THE LENS CAPSULE CAUSE CATARACT?

The experiments described have indicated that, normally, the permeability of the lens capsule is high; that the permeability decreases with age, and that in the incipient stages of senile cataract the permeability is much lower. The experiments in which the lens was preserved in sterile sodium chloride solution and became cataractous also

indicate that failure of the normal food supply of the lens and failure to remove its metabolic products produce death of the lens. A study of such autolyzed lenses with the slit-lamp and the corneal microscope, and also in histologic section, failed to reveal any differences in appearance between these lenses and cortical cataracts. It became desirable, therefore, to discover whether a decrease in the permeability of the lens capsule which was within the range of physiologic experimentation could produce the same result.

Considerable difficulty was encountered in devising a method by which the permeability of the lens capsule could be reduced without introducing into the eye toxic substances which might themselves produce cataract. It was decided finally to attempt to precipitate in the pores of the capsule some wholly inert, nontoxic substance. After many trials, it was found that eosin and gentian violet in sodium chloride solution form a heavy insoluble precipitate. Both these substances are nontoxic and may be repeatedly injected into the eye without causing cataract. Each when injected alone diffuses readily into the lens.

A preliminary experiment was performed in vitro to discover the degree of impermeability which is produced when eosin-gentian violet is precipitated in the pores of the lens capsule. A pig's lens capsule, prepared and washed as described, was tied onto the end of a glass tube. Gentian violet dissolved in salt solution was placed in the inside of the tube and the capsule was immersed in a solution of eosin in salt solution. No gentian violet appeared in the diffusate as was to be expected. After one hour, the tube was removed and the capsule gently washed. Its permeability for various substances was then tested. It was found impermeable to hemoglobin, slightly permeable to crystal violet and vital red and freely permeable to true solutions. The reduction in permeability produced by this precipitation was, therefore, only slight and not beyond the limits of change conceivable in vivo.

A series of experiments was then performed in which solutions of eosin and gentian violet were injected successively into the vitreous of rabbits' eyes. All solutions were made up in physiologic sodium chloride solution. One per cent solutions of each of the dyes were used. The usual aseptic precautions were used, and special care was taken not to injure the posterior surface of the lens with the injecting needle. Table 6 presents the result of one such experiment with appropriate controls. In rabbit 1, right eye, and rabbit 2, left eye, visible precipitation of eosin-gentian violet occurred in or on the posterior lens capsule, and cataracts developed. Rabbit 1, in the left eye, and rabbit 2, in the right eye, showed that both gentian violet and eosin could be injected separately into the vitreous without producing cataracts. Rabbit 3, in the right eye, showed likewise that the mixture, precipitated before injection, did

not produce cataract. The positive results obtained are to be attributed, therefore, not to any toxic action of gentian violet or of eosin or even of the mixture of the two, but to the formation of a precipitate in or on the lens capsule. The preliminary experiment had shown that even in vitro the degree of impermeability caused by this precipitation was not extreme. One must conclude, then, that only a relatively slight

TABLE 6.—*Results of Experiments in Which Eosin and Gentian Violet Were Precipitated in the Pores of Lens Capsules of Rabbits*

Rabbit	Eye	0.1 Cc. Injections into Vitreous			Results		
		First Day	Second Day	Third Day	Two Weeks	Two Months	Six Months
1	R	Eosin	Eosin	Gentian	Aqueous clear; precipitate in posterior capsule; vitreous stained with gentian; fundus not visible	Aqueous clear; posterior cortical cataract; vitreous slightly turbid; retinitis proliferans	Mature cataract
	L	Eosin	Eosin	Eosin	Aqueous, lens and vitreous stained with eosin	Aqueous, lens and vitreous clear; slight retinitis proliferans	Same, lens clear
2	R	Gentian	Gentian	Gentian	Aqueous, lens and vitreous stained with gentian; fundus cannot be seen	Aqueous and lens clear; still some gentian in vitreous; beginning retinitis proliferans	Lens clear; gentian has disappeared; retinitis proliferans
	L	Gentian	Gentian	Eosin	Aqueous clear; precipitate in posterior capsule and in vitreous; fundus not seen	Posterior cortical cataract; strands of precipitate in vitreous; beginning retinitis proliferans	Mature cataract
3	A	Mixture*	Mixture	Mixture	Aqueous and lens clear; heavy precipitate in vitreous; fundus not seen	Aqueous and lens clear; moderate precipitate in vitreous; retinitis proliferans	Aqueous and lens clear; retinitis proliferans
	L	Sodium chloride solution	Sodium chloride solution	Sodium chloride solution	Media clear; small hemorrhage and choroidal atrophy at site of needle punctures	Media clear	Media clear

* Equal parts of eosin and gentian violet solutions mixed and allowed to precipitate before injection.

reduction in the permeability of the lens capsule is required in order to obstruct the metabolic processes of the lens sufficiently to cause cataract. This conclusion, together with the data given, justifies the statement of the theory that some forms of senile cataract are caused by an exaggeration of the decrease in the permeability of the lens capsule which normally takes place with increasing age. The influence of cataractous lens cortex in increasing the permeability of the capsule explains why senile cataracts are not, in general, uniformly progressive.

CONCLUSIONS

1. There are no pores in the lens capsule visible with the microscope or ultramicroscope.

2. The lens capsule carries a negative electrical charge when placed in physiologic sodium chloride solution.

3. The permeability of the lens capsule is qualitatively the same in vivo as in vitro.

4. The capsule is permeable to all electrolytes and true solutes in water, and also to small and medium-sized colloidal particles.

5. In relation to all the substances tested, the capsule acts as an inert, semipermeable membrane. No instance of anomalous osmosis was encountered in this study.

6. The permeability of the capsule is decreased by calcium, cyanide and proteins.

7. The permeability of capsules from adult animals of different species varies considerably from one individual to the next, but no significant differences were found as between different species.

8. The permeability of lens capsules from young animals showed much less individual variation than that of lens capsules from adult animals. The permeability of capsules from young animals was much greater than that of lens capsules from adult animals.

9. Prolonged exposure of the capsule to the action of cataractous lens cortex increases the permeability of the capsule. This fact is useful in explaining the resorption of hypermature cataracts and the intermittent course of development of most senile cataracts.

10. The permeability of capsules from cataractous lenses varied within normal limits, but was much less than that of capsules exposed to the action of autolyzed lens cortex in vitro.

11. Normal lenses, kept in sterile salt solution at body temperature become cataractous if foodstuffs are not supplied and metabolic products not removed. Such cataracts resemble, both on slit-lamp and histologic examination, spontaneous senile cortical cataracts.

12. A slight decrease in the permeability of the lens capsule, experimentally produced, results in cataract formation in vivo.

IRIDOTASIS FOR PRIMARY AND SECONDARY GLAUCOMA *

GEORGE HUSTON BELL, M.D.
NEW YORK

New operations for glaucoma are being proposed and old ones revived. Probably no one operation will ever meet the requirements of all ophthalmic surgeons.

Iridotasis was first brought out by Borthen [1] of Norway, in 1911, when he reported 97 cases of glaucoma in which the patients were successfully operated on by "his method." In 1917, Harrower [2] also made a report on 23 successful cases before the American Ophthalmological Society. In 1923, W. H. Wilder [3] made a similar report before the American Medical Association on 36 cases. M. Goldenburg [4] reported favorably on 105 cases, and now I shall report on 40 cases, in which operations were done at the New York Eye and Ear Infirmary according to Borthen's method.

The unsurgical principle involved, the incarceration of the iris in the limbal wound, kept me, like most ophthalmic surgeons, from doing this operation years ago. As Goldenburg [4] pointed out, a few surgeons still maintain this attitude. However, it is not based on clinical results, and these, after all, are the factors that count with patients suffering from glaucoma.

My operative experience with glaucoma has not been as large as one would suppose from the fact that I have a clinic at the New York Eye and Ear Infirmary, for the reason that all of my patients with glaucoma, except those with the acute inflammatory types, are examined thoroughly, and are also given the "acid test" for the "three T's" (teeth, tonsils and toxemias of the intestinal tract), before any operation is considered. Briefly, my rules for treating patients with chronic types of primary glaucoma and also secondary glaucoma are:

1. Get rid of all dead teeth, fixed bridges and oral sepsis.

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* Read before the Section of Ophthalmology, New York Academy of Medicine, Oct. 21, 1929.

* Read at the Annual Meeting of the Virginia Society of Otolaryngology and Ophthalmology, Staunton, Va., April 27, 1929.

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2. Enucleate the tonsils, if this has not already been done.

3. Do Wassermann and blood pressure tests and urinalysis.

4. Determine the chemical analysis of the blood and make examination of the feces.

5. Have the patients examined for any endocrine disturbance.

6. Prescribe a diet and acidophilus milk and lactose. Instill 2 per cent pilocarpine into the eyes three times daily, and apply hot applications to them for twenty minutes three times daily. A hot bath should be taken at bed time. The bowels should move freely every day. Give an enema once a week and a full dose of castor oil once a month.

I have the records of more than fifty patients with glaucoma whom I am treating according to this method, and who so far have not come to operation. If the fields and vision can be controlled and the tension can be kept under 26 mm., according to the Schiötz tonometer, operation is not performed.

In 1919, Weeks [5] pointed out that 90 per cent of all patients with "idiopathic" glaucoma (except infantile glaucoma) have a history of constipation. He said that the correction of this condition goes far to relieve the hypertension.

LaGrange, who has had a wide experience in glaucoma, said, "Glaucoma is a sick eye in a sick body." Passow, of Munich, recently reported determinations of the basal metabolism in forty-eight patients with primary glaucoma. In 83 per cent, the basal metabolism was increased. As a result of these observations, important conclusions can be drawn as to the treatment for glaucoma. Thyroxin preparations, iodine and all preparations that cause an increase in metabolism are prohibited. It is a fine thing that the study of the basal metabolism in patients suffering from glaucoma and in normal persons is being stressed. Hildesheimer of Berlin agreed with Passow with regard to the etiology of glaucoma and added, "one cannot go so far as to say that glaucoma is a thyro-toxicosis, but can only say that thyrotoxic stigmatized patients tend to show increased tension in the eye."

TECHNIC OF IRIDOTASIS

Great care must be taken with all patients who undergo intra-ocular operations. As Fox [6] has pointed out, the emphasis laid on this work by me [7] is by no means overdrawn.

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5. Weeks, John E.: Treatment of Glaucoma, Tr. Sect. Ophth., A. M. A., June, 1919, p. 290.

6. Fox, L. W.: Tr. Sect. Ophth., A. M. A., 1927, p. 261.

7. Bell, G. H.: Danger of Infection Following Operations Where the Eyeball Is Opened, M. J. & Rec. **123**:635 (May) 1926.

One hour before the operation, 2 drops of 1 per cent solution of silver nitrate are instilled into the eye. If a patient's eye looks clinically clean, I operate regardless of the observations in the smear from the conjunctival culdesac, Lindner,[8] Lloyd Mills,[9] W. S. Franklin and F. C. Cordes[10] and others join with me in stressing the fact that 1 per cent solution of silver nitrate should be used in all intra-ocular operations to prevent primary infection. The brow, eyelids and adjacent skin are washed thoroughly with castile soap and then are painted with 3 per cent solution of tincture of iodine. While the patient is undergoing cocainization, several drops of a fresh solution of 25 per cent mild silver protein are dropped into the eye. Also, ten minutes before I start the operation I use 10 minims (0.6 Gm.) of 1 per cent solution of cocaine for subconjunctival injection. The patient is now ready for the operation. The conjunctiva is flushed with boric acid and the speculum is inserted. The conjunctiva is now grasped about 10 mm. back of the limbus and then a cut from 10 to 12 mm. long is made with Stevens' scissors, parallel with the corneal rim. The flap should not be cut down too far on the sides; only the middle portion of the flap, including the subconjunctival tissue, should be dissected down to the corneoscleral junction, care being taken not to buttonhole the flap, and to have it as thick as possible. When the limbus has been reached, the eye is held downward with a fixation forceps by an assistant, while the operator holds up the conjunctival flap with forceps so that he can see the place of entrance for his knife, and passes the point of a small keratome from 1 to 2 mm. back of the limbus into the anterior chamber, posterior to the flap, taking care not to make the scleral wound more than 4 mm. long. The sclera is penetrated obliquely and the point of the keratome enters the anterior chamber, anterior to the plane of the iris. Borthen uses a special knife which has a shoulder so that it cannot penetrate beyond a certain point. Through the small wound, with very delicate iris forceps which are introduced closed, the iris is grasped near the pupillary margin and gently pulled into the wound so that when the iris is withdrawn the pigmented epithelial layer is exposed and turned up opposite the anterior lip of the wound. The conjunctival flap is then sealed down in position and three sutures are employed. One per cent solution of atropine sulphate and 25 per cent solution of mild silver protein are then instilled and the eye is bandaged.

As Verhoeff[11] pointed out, the idea of the operation is to keep the pupillary margin of the prolapsed portion of the iris outside the corneoscleral wound. After twenty-four hours the eye is dressed. If the operation has been successful, more or less edema of the conjunctiva is observed when the eye is dressed. Beginning from twenty-four to forty-eight hours after the operation, gentle massage should be employed daily, in all cases in which the tension is not subnormal, for the purpose of gently forcing a small quantity of the aqueous through the scleral wound and causing edema of the conjunctiva. The eye is like a rubber ball and can be easily compressed; therefore one must use gentle massage and keep the wound filtering. One half of 1 per cent solution of atropine should be used at the first dressing, so

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8. Lindner, K.: Danger of Infections in Cataract Operations, Ztschr. f. Augenh. **53**:305 (Sept.) 1924.

9. Mills, Lloyd: Prevention and Treatment of Infection in Modern Cataract Surgery, Tr. Sect. Ophth., A. M. A., 1928, p. 160.

10. Franklin, W. S., and Cordes, F. C.: Post-Operative Cataract Infections, Tr. Sect. Ophth., A. M. A., 1928, p. 148.

11. Verhoeff, F. H.: Histological Findings After Iridotasis, Arch. Ophth. **45**: 5, 1916.

that paralysis of the sphincter iridis will prevent contraction and replacement of the iris. This, I think, is most important. The eye on which operation has not been done is cleansed daily, and 2 per cent muriate pilocarpine is used in it three times daily for ten days. The patient is allowed to sit up the morning after the operation. Twenty-five per cent solution of mild silver protein is now used three times daily in the eye on which operation was performed. When the patient goes home, after one week at the hospital, 2 grains (0.01 Gm.) of sulphate of zinc to 1 ounce (29.5 cc.) of boric acid solution is used regularly, night and morning, in the eye on which operation was done.

REPORT OF SEVERAL OF MY FORTY CASES

My first experience with iridotasis was five years ago, when I decided to try it instead of enucleation in cases of absolute glaucoma. To my great surprise, tension came down from 75 to 30, the eyes became quiet, there was no pain nor tenderness and the patients still had their blind eyes. I have ten such cases now.

My next experience was in a female patient, sent to me four years ago, from Amsterdam, N. Y. She had been in the care of her oculist for some time, and was suffering from anterior uveitis, with a tension of 40 mm., according to the Schiötz tonometer. The oculist had twice performed a paracentesis on the eye; each time the tension was reduced for several weeks, after which it returned. Then he sent her to me. I did an iridotasis. The tension came down promptly, and stayed down. The spots on Descemet's membrane began to absorb, and after two weeks' treatment at the New York Eye and Ear Infirmary the patient went home with normal vision. Since that time, I have been doing this operation for both primary and secondary glaucoma when necessary.

Two years ago, a patient, aged 60, came to my office with a chronic type of glaucoma. The history revealed nothing of importance. No foci of infection was found. The Wassermann reaction was negative. Chemical analysis of the blood gave negative results. The patient discovered that he was blind in the right eye five years before examination; lately there was great gain in the right eye. There was failing vision in the left eye. When he was first seen, the tension of the right eye was 70 mm.; that of the left eye, 35 mm. The disk of the left eye was cupped. The cornea was clear; the anterior chamber shallow, and vision with correction 20/50. Iridotasis was done on both eyes. The inflammation in the right eye promptly subsided, and the pain disappeared. In the left eye, one week after operation, there was a good bleb at the site of iridotasis. Tension was 20 mm., and vision was improving. One year later, the patient's right eye was quiet with no pain, but the tension was 35 mm. In the left eye, vision was 20/40; the tension was still normal.

In the acute inflammatory types, I have had four failures and six successes. In one case, three iridotases were done on the left eye. In each operation there was a fine bleb, but I think that the pupillary margin of the iris had slipped back and came in contact with the anterior lip of the wound, and that drainage was cut off. The patient refused any more operations. With miotics, tension has been held around 35 mm. The vision was 10/200. This patient, a Jew, aged 75, was blind in the right eye as a result of two operations (iridectomies) for glaucoma performed at another hospital before he came to my clinic at the New York Eye and Ear Infirmary. This was a fulminating case.

SUMMARY

I have had forty cases of glaucoma, in which fifty operations were performed, with the following results:

Acute inflammatory type.....	6 good	4 poor
Chronic type.....	10 good	0 poor
Absolute type.....	10 good	0 poor
Secondary type.....	9 good	1 poor
Buphthalmos type.....	No cases	

In my cases of absolute glaucoma, the tension has been normalized in nearly all of the eyes with one operation and no enucleations.

CONCLUSIONS

1. I think that the Reese iridectomy is the operation of choice in the acute inflammatory types of glaucoma.

2. In the chronic types, I prefer iridotasis because there is a minimum of traumatism to the eye and the iris is injured little. The operation is particularly valuable in a patient whose blood pressure is high or in whom the vessels are so fragile that a cutting operation might produce a hemorrhage of large proportions. Also, it is a valuable operation in hemorrhagic glaucoma.

3. Iridotasis is excellent in eyes operated on when the LaGrange operation, the Elliott trephine or an iridectomy has been unsuccessful. In these cases the operation can be done with a minimum of damage to the iris and produces a new filtration channel which remains patent.

4. I can see the great advantage of this operation in cases of buphthalmos.

5. In secondary glaucoma following anterior uveitis, which cannot be controlled by treatment, it is the ideal operation, as there is no hemorrhage to contend with in the anterior chamber.

6. Also in cases of secondary glaucoma following extraction of the cataract in which the lens capsule or the pillars of the coloboma do not seem to be the cause of the trouble, iridotasis is the best operation. There is no hemorrhage, a reduction of tension and less immediate risk to the eye and vision.

7. I have no trouble at the time of the operation, because I use "my method" [7] to prevent infections.

8. I have no late infections because I use the solution of zinc sulphate in the eye night and morning, after the patient returns home. This treatment with zinc is continued year in and year out.

9. As to the ability of iridotasis to bring about the drainage of the anterior chamber, Wilder said that the accumulated experience of those who have tried it is not lacking. Whether this drainage results from the drawing away of the root of the iris from the filtration angle, as Borthen claimed, or whether the incarcerated iris acts as a wedge along which the aqueous can escape into the conjunctival cellular tissues are questions which await further study and solution.

10. The only contraindication to the operation, as I see it, is in eyes that have a developing cataract complicating the glaucoma, the iridotasis bleb, which might interfere with a section of the cataract later on. In those cases I prefer iridectomy.

11. As far as I have gone with iridotasis, I am greatly pleased with the results. However, the prognosis in operations for glaucoma is unfavorable throughout, as patients usually seek treatment late in the disease.

12. The value of any operative procedure rests on at least two fundamental factors—efficiency and simplicity.

30 East Fortieth Street.

SYMPATHETIC OPHTHALMIA

THE SUCCESSFUL TREATMENT OF A PATIENT WITH AN ACUTE CASE *

G. HERBERT BURNHAM, M.D. (Tor.), F.R.C.S. (Edinburgh)
TORONTO, CANADA

Sympathetic ophthalmia apparently originates in a penetrating wound of the ciliary region of one eye, which communicates with the air. As long as it is not too large, if this wound is fully covered without delay with a fold of conjunctiva, its under surface being in contact with the wound so that it becomes adherent to it, the consensus is, I think, that it is so great a preventive that sympathetic inflammation, which otherwise would occur, may be warded off. I agree with this belief, as I have used it successfully. There seem to be three varieties, or rather degrees of severity of sympathetic ophthalmia:

The first variety is a sympathetic irritation, which goes no further; that is, the media remain clear and no visible signs of disease are found. Finally, after the removal of the injured eye, this condition disappears, and the eye becomes quiet and fully recovers.

In the second variety there is a punctate keratitis, which is, of course, a cyclitis; this progresses no further and finally slowly clears up after the removal of the wounded eye. The optic disk, according to my observation, shows no signs of being affected in either of these forms.

The third degree of severity, by far the most common, is the dreaded sympathetic inflammation, with copious exudation into the tissues of the eye. At the onset, the optic disk shows a very early state of inflammation. The diagnosis is confirmed later in this way. The use of the "combined treatment" brings about the absorption of the exudate, so that the eye is restored to almost normal vision and thus the media become clear again, and an examination of the fundus can be made.

The first patient whom I treated with the "combined treatment" was one with a virulent type of the disease. Prior to the beginning of the "combined treatment" and before the media became hazy, my last view of the optic disk showed an injected, fuzzy condition; that is, the beginning of an optic neuritis. At the termination of the treatment of this patient, that is, at the end of three years, when the exudate had been removed and the media had become clear, the optic disk was seen to be pale and scarred, as if exudate had been removed from its tissues, just as the iris showed a marked scarring after the removal of the

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exudate from its tissue. The optic disk still possessed almost full power, as the sight was almost normal and the field was normal. The iris and ciliary processes also were apparently uninjured, as the pupil was active; the anterior chamber, the intra-ocular tension and the accommodation were normal, and there was no ciliary thinning of the sclera; that is, the ciliary region was normal.

For many years, my attention has been drawn especially to the nervous system as a pathway by which something, I shall call it "influence," thereby meaning in regard to the treatment now under consideration the effect produced by the hypodermic injection of pilocarpine, travels. The "influence" thus produced is seemingly rapidly and forcibly transmitted to the tissues. Thus there passes through the nervous system an "influence" beneficial to the tissues concerned, and this seems to be the direct result of the treatment pursued. In its course, this "influence" markedly arouses among other activities those of the glandular system. I do not mention this as the only pathway, but one of the chief.

My theory regarding the action of the "combined treatment" is the same as it was in the beginning. My working hypothesis has always been as follows: The reason for the radical nature of its effect seems to be that it stimulates all the nerve centers to a remarkable degree, and through them the ordinary physiologic processes, especially those of the affected part or organ, are aroused to an activity far in excess of the normal, and thus the diseased condition is acted on and removed. Moreover, this hyperactivity can be sustained and regulated for years, if necessary, simply by following out the rules which I have so minutely given in regard to the administration of the "combined treatment." [1]

That this hyperactivity is always physiologic in its effects, that is, is never abnormal, and hence need cause no fears lest it act in an injurious way, has been my experience ever since I began the use of the "combined treatment"; however, several years elapsed before I was thoroughly aware of this fact. The perspiration produced by the hypodermic use of pilocarpine is a sign that the drug is acting properly. There are other remedies that cause diaphoresis, but their effect on the tissues is superficial and evanescent compard with that of pilocarpine. To call the "combined treatment" the sweating treatment is therefore a misnomer. To put it in the same category with other remedies, as acetylsalicylic acid, heat in many diverse forms, etc., as many investigators do, is to place it on a par with remedies to which it is decidedly superior, being more far-reaching and lasting in its effects and more potent in every respect.

1. Burnham, G. Herbert: The Combined Treatment of Diseases of the Eye, London, H. K. Lewis & Company, 1906.

The origin of sympathetic ophthalmia, I believe, is due to a certain type of inflammation, the outcome of an injury to the ciliary nerves, which results in the formation of an infective substance or condition through the exposure of the wound to the air. Thus there travels along the nerve or nerves something inimical to the welfare of the tissues concerned. This seems to be the direct result of a process begun in the wounded tissues, or rather nerves, of the ciliary region. This idea is supported by the following facts: In cases in which these ciliary nerves apparently are not implicated, as when the wound is not in the ciliary region, and in cases in which a wound of the ciliary region is not followed by any symptoms of sympathetic ophthalmia, and therefore presumably the ciliary nerves are not lacerated, sympathetic ophthalmia does not occur. That exposure to the air is necessary, save most exceptionally, to cause this condition is demonstrated by the prevention of sympathetic ophthalmia by the immediate covering of the wound with a fold of conjunctiva.

That the three degrees of severity of sympathetic ophthalmia could be ascribed to the character and the extent of the injury to the ciliary nerves is also, I think, a legitimate conclusion, and one which it appears to me, can be demonstrated in the following way.

The term, "most exceptionally," has reference to the following condition, which was exemplified as follows:

A man, an outpatient, suffering from long-standing sympathetic irritation, came to Moorfields Eye Hospital when I was resident house surgeon. The vision in the injured eye had been lost for many years; however, there was no external wound. The eye was removed, and the sympathetic irritation disappeared. An examination of the excised eye showed a long-standing osseous degeneration, which had at last reached the ciliary processes. This contact with the ciliary region had given rise to irritation of the ciliary nerves and thus had brought about a condition which eventuated in sympathetic ophthalmia of the first variety. Hence sympathetic ophthalmia of this variety had arisen without exposure to the air, which was a "most exceptional" occurrence. This state shows that sympathetic irritation is not sympathetic inflammation, but merely an irritation of the ciliary nerves, which in this case was stopped by the excision of the cause, the diseased eye.

Thus sympathetic irritation seems to be due to the abnormal condition of the ciliary nerves produced by osseous degeneration and does not progress into sympathetic ophthalmia. It seems to be caused by an irritation of the ciliary nerves in the absence of any wound in them.

In a wound of the ciliary region in which sympathetic irritation is present and continues for many months with varying degrees of severity, but after a year or so does not pass beyond the bounds of irritation, one is dealing with a case of bruising, so to speak, and an irritation of

the ciliary nerves, but not laceration. Hence one is dealing with a state similar to that present in the exceptional type due to osseous degeneration which I have mentioned. Thus on account of the absence of laceration of the ciliary nerves, penetration of them by any process developed in consequence of the injury cannot occur; or it may be that the unbroken surface of the nerves prevents the same condition of the wound to be brought about as when laceration occurs.

It is natural to deduce from these observations that a very small wound of the ciliary nerve may be the origin of a mild form of sympathetic ophthalmia. It seems to me that in this way can be explained the three varieties of sympathetic ophthalmia, why the first variety takes the course it does, the fact that the three varieties given are a natural effect and are not haphazard and the soundness of the view of the necessity of at once covering a ciliary wound with a flap of conjunctiva.

Professor Fuchs [2] found a certain pathologic condition in an eye with a wound in the ciliary region, which he considered to be especially associated with sympathetic ophthalmia. On following out these cases, he was able to prove that in thirty-five patients in whom one eye was wounded sympathetic ophthalmia developed in the other eye. These cases showed extensive pathologic changes in the excised eye. These marked changes were evidently present only in virulent cases, as it has been shown that in milder forms, those changes which Fuchs mentioned as present and peculiar to sympathetic ophthalmia are absent or so lessened as no longer to be distinctive.

If the injured eye has good vision, even though sympathetic ophthalmia is present, I should not remove the injured eye, for the use of the "combined treatment" would be followed by the recovery of both eyes. In a case in which I fully expected sympathetic ophthalmia, if the injured eye had good vision, I should begin treatment before the sympathetic ophthalmia showed itself. If the injury were of such a character that good vision was impossible, I should not attempt to save the injured eye.

During my years as house surgeon at Moorfields Eye Hospital, an outpatient, suffering from sympathetic ophthalmia, presented himself. Both the injured eye and the sympathetically inflamed eye had good vision. It was decided not to remove the wounded eye, because if the sympathetic ophthalmia became severe, the wounded eye would be more likely to retain good vision than the other. According to my present belief and knowledge, I should have given the same decision, but with the firm conviction of being able to preserve good vision in both eyes.

I shall now report a case of acute sympathetic ophthalmia.

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2. Fuchs: Text-Book of Ophthalmology, ed. 6, Philadelphia, J. B. Lippincott Company, p. 438.

REPORT OF CASE

History.—Lois S., of Toronto, aged 5½ years, consulted me on March 14th, 1924. The right eye had been wounded in the ciliary region on Dec. 27, 1923. Early in February, 1924, shrinking from light was said to be first noticed. Three weeks before I was consulted, the injured eyeball had been removed by an oculist.

The pupil was fully and roundly dilated with atropine; there was no injection of any moment, and slight punctate keratitis was present. The eye was in a quiescent state, but the mother said that it had been irritable, red and painful a few days before; there evidently was a lull in the inflammatory symptoms. My advice was the use of "combined treatment."

Course and Treatment.—The patient was not seen by me from March 14 until May 5, when she presented decidedly pronounced sympathetic ophthalmia; she had had attacks of pain at intervals, and the eye was markedly injected; vision was light perception only; the pupil was dilated but adherent; the iris tissue was swollen and thickened from exudate; bombé patches were present; lymph filled the pupillary area, and keratitis punctata was present. Tension was plus 2; the anterior chamber was shallow, and there was much ciliary injection. The mother said that a few days before they had come to see me there had been a severe attack of pain. The eye was very red and vision was light perception. In other words, this was a typical case of acute sympathetic ophthalmia of the third degree of the most severe type. I again advised the use of the "combined treatment."

Of course, in a severe and acutely active condition of sympathetic inflammation, it always takes a variable length of time before the inflammation can be checked. When this desirable end is attained, then and then only does removal, called absorption of the exudate, begin to take place. This removal is necessarily slow, but can be accomplished with certainty by the use of the "combined treatment."

When some time during the treatment there is no sign of injection of the eyeball and photophobia is absent, in other words, when the eye is quiet and remains so, then and then only can one apparently be sure that advancement of the process has definitely stopped.

On July 4, five and one-half weeks after the first series of treatments, one of twenty injections was given. Ciliary injection was still seen, but there was no pain; the tension was plus 1; there was no ciliary thinning; there was a marked ground glass appearance of the cornea and keratitis punctata was present.

On August 24, two weeks after the patient had received the ten injections, the tension was plus, but there was more elasticity; the ciliary region was quiet. The mother said that ten days previously the eye was red and vision poor. The week before the patient had accidentally struck the eye. The tissue of the iris was improving.

On October 30 the tension was normal, and the eye was doing well.

From Dec. 29, 1925, after the first series, a series of ten subcutaneous injections of pilocarpine had been given every six weeks, as after the first series of injections the series always consists of ten injections. The improvement had been steady, and no relapse had occurred. The vision was slowly getting better, but as the patient did not know her letters—having been taught to read by sound—her mother began to teach her the alphabet. After she had learned this, I began to test the eye as to the actual amount of vision. In the left eye vision was 4/60; the pupil was slightly more contracted and rounder, but was still

dilated and adherent. I never use atropine in cases of this kind, for of what possible service can it be? It only irritates the eyeball, and any constitutional effect would help to neutralize the action of the pilocarpine. In the beginning the pupil was dilated with atropine, and hence, as the lymph poured out freely, it was held in that position. The process of absorption was excellent in every part of the eye.

On April 13, 1926, the series of injections was continued at the same intervals until the treatment was stopped. The vision in the left eye was 6/30 plus.

On October 4, vision in the left eye was 6/21 plus, the tension was normal, there was still a thin membrane on the lens capsule in the pupillary area, progress was satisfactory and the general health was excellent.

On November 26, the vision in the left was 6/15 plus. The patient was doing well; the details of the optic disk or fundus could not be made out, as there was still a slight membrane in the pupillary area.

On March 27, 1927, the vision in the left eye was 6/15. The optic disk was pale, and by its appearance gave the impression that the removal of exudate from its tissue was taking place.

On September 24, vision in the left eye was 6/15.

On November 17, the vision in the left eye was 6/12.

On Jan. 11, 1928, vision in the left eye was 6/12.

At this time it was about three years and nine months since I began the "combined treatment" in this case. Six months elapsed before I could say that the visible symptoms of the inflammatory process had ceased. Therefore, it had presumably taken more than three years for the "combined treatment" to inaugurate and perpetuate a process of absorption capable of producing the effect that was manifested in January, 1928. In order to bring about so great a clearing up of the condition of the eye as almost to restore normal vision, one additional year of treatment, I thought, would be needed. When the condition was cleared up, not only would the eye be healed and have almost normal vision, but the health of the patient would be excellent. The result as to both the eye and the general health, I knew from experience, would be permanent.

In the treatment, the strength of each hypodermic injection was from $\frac{1}{12}$ to $\frac{1}{6}$ grain (0.0054 to 0.0108 Gm.), or a shade more in a series of ten injections, and was given every day about 3 or 4 p. m. After one and a half or two hours the patient could get up and be dressed, the patient being wiped dry. She must remain in the house until bed time. The next morning, however, freedom in the house or outdoors was permitted until the injection was given in the afternoon. The use of mercury and the sodium iodide and bromide was continued between the series in the "combined treatment," hence its name.

The tissue of the iris was gradually being freed from the exudate and also the pupillary area. The optic disk, though pale, was gradually assuming a more healthy hue, as its smaller vessels became more evident. When the "combined treatment" was stopped, I fully expected that there would be almost normal vision and other conditions similar to those in the case I have referred to. The process of removal of exudate was satisfactory, and the vision was 6/12 in January, 1928. Ten injections were again administered and were continued every six weeks until the treatment was stopped.

On June 19, the vision was 6/15, not improved by glasses; the media were clearer, and the right eye was improving.

On August 10, the vision was 6/15 plus, not improved by glasses; the media were clearer, and the right eye was improving.

On October 6, the vision was 6/12, doubtful; the media were clearer, and the right eye was improving.

On December 1, the vision was 6/12 clearer and was not improved by glasses; the media were clearer, and the right eye was improving.

The temporary deterioration of the vision, so noticeable, seems to have been due to the removal and thinning of the pupillary exudate, giving rise to an irregularity of the surface of the curtain, as it were, and hence though the fundus was better seen and healthier, the vision was poorer.

On Jan. 23, 1929, the vision was 6/15 and 6/12.

On March 16, the vision was 6/12; with a —1.50 spherical lens it was 6/9. The left eye was decidedly more normal in appearance, and the tissue of the iris was slowly losing the scarred appearance as the exudate was being gradually removed. On May 9, the vision was 6/12; with a —1.50 spherical lens it was 6/9; the left eye was improving. There was one place through which I could clearly see the fundus. Ten injections were given and were the last, that is, the course was ended.

On August 26, the tension was normal; the vision was 6/9 without glasses. On the lens capsule in the center of the pupillary area there was a little uneven residue of the exudate, and this was the reason that the vision fell short of normal. The pupil was active, but its movements were restrained in certain spots by a small remnant of exudate still unabsorbed. The left eye looked very well and was of good color, but the surface and edges showed evidences of the optic neuritis through which it had passed.

If the "combined treatment" had been begun at the first visit in March, the length of time involved in its use would have been decidedly lessened, i. e., by one or perhaps even two years. The sympathetic inflammation set in at least three months before the "combined treatment" was allowed to be used, and hence the disease had become more extensive and firmly established, and the case a much more serious one to deal with. As a result of the delay, the exudate, of course, became more fully organized, and thus not only was it removed more slowly, but could not be removed as completely; hence the acuity of vision was affected. In this case, as a consequence, it seems impossible so fully to clear the capsule of the lens of a film of exudate as to get instead of the two-thirds normal vision the almost normal vision that I anticipated.

This case can be said to demonstrate the importance of beginning the treatment of these patients and ones with allied conditions, in fact of any patient on whom it is used, at the earliest possible moment. It also demonstrates that any delay lessens one's ability to remove fully the exudate and thus to obtain correspondingly good vision; it also lengthens the time that the treatment must be used.

My solution consists of: pilocarpine muriate, 5 grains (0.3 cc.) to 1 drachm (3.75 cc.); that is, $\frac{1}{12}$ grain (0.0054 Gm.) to 1 minim (0.06 cc.). In this case I began with an injection of 1 minim, but gradually increased the dosage, and for several years I have been using 2 (0.12 cc.) and often 3 minims (0.18 cc.). I have not used 3.5 minims (0.21 cc.) as that dose would cause an unnecessary and too strong reaction. The repetition of too strong a reaction produces

weariness of the nervous system; that is, a stale condition because the nervous system is overworked, which state must be guarded against as much as too slight an effect. Each is unsatisfactory and can with certainty be avoided by following the rules laid down.

CONCLUSIONS

Thus it appears to me natural to draw the following conclusions:

After the removal of the wounded eye, the patients with the first two varieties of sympathetic ophthalmia will recover without treatment, but more quickly with treatment; this is true especially of those with the second variety.

The patients with the third variety, however, will not recover unless treatment is used. By recovery I mean, not only the cessation of inflammation and that the eye remains quiet, but the removal of the exudate so that the media become so clear that there is good vision and the fundus can be examined, no operation having been performed. Sometimes after the use of other modes of treatment, viz, the administration of neoarsphenamine, and massive doses of salicylates, patients with the milder type of the third variety recover with good vision. Sometimes the exudate is unabsorbed. Then the procedure is to perform an operation, which results in various degrees of vision and a mutilated eye. This is not an ideal recovery, as the vision is poor and the exudate is unabsorbed. With the use of the "combined treatment," however, the exudate would have been absorbed and good vision attained. Besides, this good result could have been foretold from the beginning of the "combined treatment," whereas with any other treatment no such assured promise would or could have been volunteered with any degree of certainty.

The third variety is that which tests the respective curative properties of remedies. The treatment on which I rely and the use of which enables me to give a favorable prognosis, especially if I begin its use early in the disease, is the "combined treatment." I have found this form much more effective and reliable than any other. In the mild types of the third variety, as already noted, other modes of treatment have a good curative effect. When these fail, however, and in the most severe types I think they always do, my advice would be to fall back on the "combined treatment," having been taught by observation and experience that in it there seems to be a peculiarly powerful remedy, which appears to have the property, the innate selective quality, of bringing to its assistance, or rather drawing on, tapping as it were, the vast reserve of the various healing forces ever present in the body. In other words it seems to give to the normal physiologic processes the needed stimulus to arouse in them an increased effort, apparently similar in character to that mysteriously caused activity known as "spontaneous cure."

Ophthalmologic Review

RETROBULBAR NEURITIS *

EDWIN BLAKESLEE DUNPHY, M.D.
BOSTON

Ophthalmic literature is full of articles and discussions on retrobulbar neuritis. Not only is there considerable difference of opinion in regard to its etiology, but the confusing terminology of optic neuritis, papillitis, choked disk, etc., has made it difficult to determine just which signs and symptoms constitute the disease.

Therefore, it may be well to state that retrobulbar neuritis in this article means the symptom complex consisting of rather rapid loss of visual acuity associated with a central scotoma and usually normal, but at times varying, peripheral fields. There may be pain and tenderness on moving the eyeball. The ophthalmoscopic picture is usually normal, but in some cases the disk shows blurred margins and congestion of the vessels. The disease may attack one or both eyes. There is a definite tendency toward recovery, although in some cases sight is irreparably damaged. Recurring attacks are not infrequent.

The close relationship of the optic nerve to the posterior nasal sinuses has led many to look to these structures for the cause. Van der Hoeve suggested three ways in which disease may affect the optic nerve: (1) by direct spread of inflammation, (2) by pressure due to distention of the walls of the sinus and (3) by the irritating influence of toxins causing edema and stasis.

Mayou expressed the belief that retrobulbar neuritis probably never occurs as a result of direct spread of infection to the nerve, but may be caused by embolic infection through the blood stream from a septic focus elsewhere, such as an infected sinus. However, Van der Hoeve has demonstrated pathologically in one case how inflammation can spread from the sinus to the optic nerve by penetrating the bony separating wall.

In view of the great prevalence of sinus disease, it would seem strange that retrobulbar neuritis develops in so few cases. Beck studied ninety-one cases of indisputable empyema of the accessory sinuses and found only one case of retrobulbar neuritis among them. In an additional series of one hundred and eighty-nine cases of sinus disease, no case of retrobulbar neuritis was observed. This may be explained by

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* From the Department of Ophthalmology, Harvard Medical School.

anatomic variations. Onodi demonstrated that the optic nerve can pass, unprotected by any bony shield, through an ethmoid cell or even through the sphenoid sinus, whereas, on the other hand, the nerve is often surrounded by a thickened bony wall. The anatomic relations, therefore, may be a great factor in determining whether or not the optic nerve will be attacked.

A great many radical operations have been done on the posterior sinuses for cure of retrobulbar neuritis, and many brilliant results have been reported. In many cases, however, no disease of the sinus was found, and yet the patient's vision improved. Thus Beck reported that on histologic examination of material recovered in four cases in which operations were performed on the sinus, no evidence of acute or chronic inflammation was found. In all four cases, however, the retrobulbar neuritis disappeared.

Turner studied twenty-five cases of retrobulbar neuritis over a two year period. In all these cases there were no subjective sinus symptoms nor any definite evidence of suppurative disease of the sinus. In six cases the sinuses were opened and nothing was found. All twenty-five cleared up with practically normal vision.

A great deal of work was done on this question by Leon White. He felt that poor ventilation and faulty drainage of the posterior sinuses were important predisposing factors. He believed that no one etiologic condition could account for all cases. He felt hyperplasia of the ethmoids to be one of the main causes. He advocated early aeration of the sinuses, even though the roentgenograms were negative. He reviewed the end-results of thirty-two operations on the sphenoid sinus for disturbances of the optic nerve. All the patients improved except three, in whom permanent changes had taken place. He laid stress on the size of the optic canals as an important factor in damage of the optic nerve. Carefully standardized roentgenograms of twenty-five cases showed the average optic canal to be about 5.3 mm. in diameter, although it varied from 3.5 to 6.5 mm. In a study of sixty-seven cases of optic atrophy, he found that the smaller canals were more conducive to atrophy. He felt, therefore, that visual recovery might be expected when the canal was normal. When retrobulbar neuritis occurred in patients with normal or large optic canals, he thought that it was probably due to extranasal origin, such as toxic absorption from the teeth or tonsils.

White later modified his views somewhat, laying more stress on focal infections (chiefly those of the teeth and tonsils) than on direct extension of inflammation from the accessory sinuses. He stated that the benefits usually following the opening of the posterior sinuses resulted from relief from negative pressure and not from removal of a focus of infection. This negative pressure, owing to poor drainage

and ventilation, would probably favor the migration of bacteria and toxins from the blood stream to the optic nerve.

The individual resistance of the nerve to the toxemia or pressure may be a factor in its recuperation, as shown by Van der Hoeve's pathologic demonstration of two cases. One case showed a definite degeneration of the papillomacular fibers, while the other showed no change in the nerve, although the central scotoma had been present for several months.

Many surgeons deprecate opening the sinuses for cure of retrobulbar neuritis in the absence of frank pathologic changes. Thus Chaillons reported four cases with spontaneous recovery in which, had a sinus operation been performed, the cure would have been attributed to it.

Weill stated that 85 per cent of his thirty-four patients recovered without surgical intervention on the sinuses.

Lenoir and Beaujeu reported fifteen spontaneous cures without intervention on the sinuses.

Shumway reported the case of a young man who consulted him because of a unilateral retrobulbar neuritis. Ethmoiditis was found, for which operation was performed. Some improvement of vision followed for a while, but later multiple sclerosis developed.

Willebrandt and Sanger called attention to the similarity between retrobulbar neuritis and multiple sclerosis. In both there may be sudden loss of vision accompanied by pain in the head and orbital pains and spontaneous improvement. They said, however, that a probable diagnosis of multiple sclerosis should not be made until the toxic, hereditary and infective processes that attack the optic nerve can be excluded.

Uhthoff's statistics of one hundred cases of multiple sclerosis show that in 50 per cent there are varying degrees of change in the optic nerve.

Statistics of many authors have proved beyond doubt that multiple sclerosis may be an important cause of retrobulbar neuritis. Thus Davis found fourteen cases of multiple sclerosis in seventy-six cases of retrobulbar neuritis. Langenbeck found the following etiologic results in a study of 176 cases of retrobulbar neuritis: multiple sclerosis, fifty-eight cases, 33 per cent; suspected multiple sclerosis, fourteen cases, 8 per cent; syphilis, thirteen cases, 7 per cent; sinus disease, six cases, 3.5 per cent. The remainder he attributed to various causes, such as diabetes, rheumatism and gout.

Fleischer studied the subsequent histories in thirty cases of retrobulbar neuritis seen in the Tubingen Clinic. He found that in 66 per cent multiple sclerosis developed. Tarle confirmed the view that retrobulbar neuritis is an early and important sign of multiple sclerosis. He investigated whether any neurologic evidence of concurrent disease

of the central nervous system was present at the time of the acute retrobulbar neuritis. Eleven of his twenty-nine cases of retrobulbar neuritis were diagnosed multiple sclerosis.

Roenne called attention to the fact that retrobulbar neuritis may occur in the chiasm. Preliminary headache is common. Field changes are characterized by the association of hemianopic defects with central scotomas in many combinations and variations. A wandering character of the field defects is common and can be explained by the presence of disseminated foci in the chiasm and tract of the optic nerve which arise and subside. Choked disk may be present but not, he believed, directly connected with the diseased area or concerned with the functional defects. He tabulated ten cases, in five of which onset was accompanied by headache. In six cases nervous disturbance was present in other parts of the body.

Traquair reported four cases of chiasmal retrobulbar neuritis in women from 21 to 36 years of age. None showed at the time, or developed subsequently, any definite evidence of nervous disease, the duration of observations having been two, three, four and thirteen years. Field changes showed pronounced central defects of a hemianopic nature and relatively little peripheral disturbance. All the patients recovered perfectly. No marked papillitis was present. When field defects are homonymous, it is necessary to exclude suprageniculate lesions. The latter rarely if ever cause a central defect, especially of variable character. Tumors and aneurysms must be excluded. The field here would probably become progressively worse instead of getting better or changing rapidly.

Kennedy pointed out the diagnostic value of retrobulbar neuritis in expanding lesions of the frontal lobe, illustrated by a case of ruptured aneurysm of the right internal carotid. The sign he emphasized is the occurrence of a true retrobulbar neuritis with the formation of a central scotoma and primary atrophy on the side of the lesion together with (if the pressure is sufficiently great) ipsolateral anosmia and papilledema in the opposite eye. Papilledema is generally believed to be the result of forcing fluid out of the cerebrospinal pond down the vaginal sheath of the optic nerve to the nerve-head, where its accumulation is seen by the ophthalmoscope as a localized swelling. This is the case brought about by an expanding lesion anywhere in the cranial cavity, as long as this lesion does not take origin, from the beginning, directly in contiguity with the optic nerves themselves. If the latter occurs, a completely different series of events takes place. There is an obstruction of the vaginal sheath preventing fluid from being forced down it, and atrophy develops by direct pressure.

Retrobulbar neuritis has been reported by many authors as due to various foci of infection.

Calhoun reported three cases of retrobulbar neuritis in which malarial parasites of tertian type were found in the blood. The patients recovered with normal vision after treatment with quinine. Two cases were bilateral and one was unilateral. In all three cases the Wassermann reaction was negative and there was no evidence of sinus disease.

Allport reported the case of a boy, aged 18, who had acute unilateral retrobulbar neuritis due to intestinal toxemia. Immediate cure followed proper treatment.

Francis reported two cases, one unilateral and one bilateral, in which the only positive observation in a complete physical examination was marked acetonuria. This was probably only an index of an existing toxemia elsewhere. Both patients recovered.

Clark reported a case of bilateral retrobulbar neuritis with observations of *Bacillus subtilis* in the cerebrospinal fluid. This was found by two laboratories on repeated examinations. All other tests gave negative results. There was total blindness with complete recovery.

Pihl reported a case of retrobulbar neuritis caused by a suppurative antrum. Repeated attacks were cured by drainage.

St. Martin reported cases of typical retrobulbar neuritis apparently due to abscessed teeth. On removal of this focus, sight returned.

Zaniloni said that in 95 per cent of cases of retrobulbar neuritis periostitis of the root of the premolars is the cause. The medium of infection is the blood vessels, periosteum, cellular tissue and perhaps nerves. From the molars there extend bony channels through the upper jaw to the sinus lacrimalus and to the lower orbital margin. The pathologic material may pass through venae vorticosae and posterior ciliary veins to the choroid and through the central vein to the optic nerve and retina. The teeth in the lower jaw can also cause inflammation of the eye, probably metastatic.

Parsons spoke of the pupillary reaction in retrobulbar neuritis. The pupil contracts slowly and then dilates even though the illumination is continued. This lack of sustained contraction is not limited to retrobulbar neuritis but can occur in other cases in which there is interference in conductivity of new fibers without complete block, i. e., retinitis and choroiditis with exudation in the nerve fiber layer. In these cases, however, there are usually gross manifestations of disease in the retina to make the proper diagnosis.

Toxic amblyopias have definite central scotomas and were formerly called chronic retrobulbar neuritis. Birsch-Hirschfield's experimental work tended to show that in these toxic cases there was a primary degeneration of the ganglion cells in the retina, as proved by changes in the nissl granules of the cells. These are more pronounced in the macular region. Therefore the changes in the optic nerves are due to secondary degeneration of these axons.

The principal cause of toxic amblyopia is the excessive use of alcohol and tobacco, but other substances such as stramonium, chloral, iodoform, carbon bisulphide and aniline are said to produce the same picture.

A chronic type of retrobulbar neuritis is occasionally found in diabetes and may be the only ocular symptom of this disease. De Schweinitz felt that this so-called glycosuric amblyopia is more apt to be found in diabetic persons who use tobacco freely than in those who are abstainers.

It is possible that some other cases of retrobulbar neuritis from toxic sources, such as dental sepsis and intestinal toxemia, may be due to primary involvement of the ganglion cells.

Stark suggested the theory of anaphylaxis to account for some cases of retrobulbar neuritis. He expressed the opinion that there may be a sensitization of tissues of both the sinus and the orbit by bacterial proteins, producing an allergy, resulting in a localized anaphylatic reaction each time the person comes in contact with a fresh infection of the same bacteria in the nose and possibly in other parts of the body. For that reason, many of these cases give a history of acute coryza shortly previous to the eye trouble.

Leber's disease may be considered a form of retrobulbar neuritis. It usually occurs in males by heredity, sometimes in females. Starting about the twentieth year, the vision fails rapidly at first, then gradually becomes stationary. Both eyes are always affected, although one may be affected several months before the other. In two thirds of the cases there is a central scotoma. The peripheral fields are usually normal at first, but later may show contraction. Complete blindness may occur. The disks are normal in the beginning, but atrophy finally develops.

SUMMARY

The conditions causing the picture of retrobulbar neuritis are many and varied:

1. Inflammation may be communicated to the nerve from adjacent structures.

2. Toxins may be carried to the nerve by the blood stream: (*a*) from foci of infection or (*b*) through alcohol and tobacco amblyopia.

3. Inflammation in the nerve may be a local manifestation of a general disease such as gumma or tubercle.

4. Involvement of the nerve may be part of a disease of the central nervous system caused by: (*a*) multiple sclerosis or (*b*) pressure from expanding lesions of the frontal lobe.

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News and Notes

EDITED BY DR. JOHN HERBERT WAITE

UNIVERSITY NEWS

The Commonwealth Fund of New York City has just made a gift of $250,000 to the Department of Ophthalmology of Washington University for research in trachoma over a period of five years. The Board of Commonwealth Fund indicated that it would be inclined to continue the grant beyond the five year period on the basis of demonstrated results and continued need. The research in trachoma and allied diseases will be conducted in the Oscar Johnson Institute of which Dr. Harvey J. Howard is the director. The Oscar Johnson Institute and McMillan Hospital are now being erected by Washington University and should be ready for occupancy the latter part of this year. Dr. Charles Weiss and Miss Marion Morris, with the assistance of technicians, are already working with Dr. Howard on the bacteriologic and cytologic phases of the trachoma problem. The gift from the Commonwealth Fund and the facilities of the new Oscar Johnson Institute will make it possible to organize an all around attack on the problem.

James Metcalfe MacCallum has been made professor emeritus of ophthalmology in the University of Toronto on his retirement from the chair, which he has held since 1903. For twenty years he has represented the university on the Ontario and the Dominion Medical Councils. To him the profession owes "The Drugless Healers Act," the best solution of the relationship of the cults to scientific medicine. Professor MacCallum is known in the history of art as the discoverer and friend of Tom Thomson, Canada's greatest landscape painter, and also for the part he has played, along with the Group of Seven, in the art movement which has swept Canada from ocean to ocean.

The appointment of William Herbert Lowry as professor of ophthalmology in the University of Toronto is announced. Graduating in 1901, he was appointed to the faculty in 1912, and has occupied the post of chief surgeon to the Hospital for Sick Children. He is now chief surgeon at the Toronto General Hospital.

SOCIETY NEWS

North Dakota Academy of Ophthalmology and Oto-Laryngology.—The January meeting of the North Dakota Academy of Ophthalmology and Oto-Laryngology was held in Fargo on January 11, under the presidency of Dr. George M. Constans of Bismarck. Case reports were given and an illustrated address was presented by Dr. Horace Newhart of Minneapolis.

Rochester Eye, Ear, Nose and Throat Club.—Dr. F. H. Verhoeff of Boston addressed the club at its annual dinner meeting, on the subject, "The Intracapsular Extraction of Cataract." The meeting was well attended.

Chicago Ophthalmological Society.—At the thirty-eighth annual meeting, held on January 20, Dr. Hanford McKee, the guest of honor, talked on "Cases from a Pathological Notebook." This was followed by a talk, illustrated with motion pictures, by Mr. Will J. Cameron on "From Capetown to the Belgian Congo."

Eye Journal Club of Chicago.—An association of ophthalmologists, which meets to discuss abstracts of the foreign literature, held a meeting on January 23. Dr. William Moncreiff, 55 East Washington Street, is secretary.

CORRECTION

In the article by Dr. Joseph I. Gouterman, "The Rôle of Calcium in Essential Glaucoma" (ARCH. OPHTH. **2**:670 [Dec.] 1929), the second sentence in the last paragraph on page 670 should have been enclosed in brackets.

In the first paragraph under the center head "Experimental Observations on the Rôle of Calcium in Glaucoma" on page 672, the third sentence should read: "Sollman[9] stated that excess of calcium ions tends to depress and their deficiency to increase excitability."

Obituary

HAROLD GIFFORD, M.D.

1858-1929

Harold Gifford was born in Milwaukee in 1858; he died suddenly on the morning of Nov. 28, 1929, aged 71 years. He graduated with the degree of bachelor of science from Cornell University in 1879, and received his medical degree from the University of Michigan in 1882. A year as assistant in the department of pathology in the University of Michigan was followed by extensive post-graduate study in several of the European universities. He was appointed first assistant to Horner, then professor at Zurich and one of the foremost clinical ophthalmologists of Europe. He returned to America and located in Omaha in 1886. He put his training in scientific principles (which was unusual for that time) to good use in the problems of a busy practice, in which he was actively engaged until the time of his death.

In pure laboratory research, his early work on the experimental production of sympathetic ophthalmia, with his demonstration of the fact that organisms may travel from the inoculated eye along the lymph paths into the orbit and thence to the nerve and suprachoroidal spaces of the second eye and his work on the drainage of the anterior chamber will be remembered. In bacteriology, his contributions have perhaps been most important. He was the first to describe the fact that the normal conjunctival sac contains numbers of organisms, some of which may become pathogenic when they are carried into the eye by trauma or operations. In 1896, he gave the first description in English of the acute conjunctivitis caused by the pneumococcus, and first demonstrated that this organism was the cause of this disease, at least in the middle west. By inoculation of secretion containing the organism into his own conjunctiva and that of an assistant, he produced the typical disease. Two years later he published the first description in English of the Morax-Axenfeld bacillus as the cause of chronic conjunctivitis and of corneal ulcer. In 1910, he was the first writer in English to describe involvement of the eyelids by the sporothrix, a member of the lower fungi which causes sporotrichosis, and the first in any language to describe a peculiar form of involvement of the ocular conjunctiva with this organism.

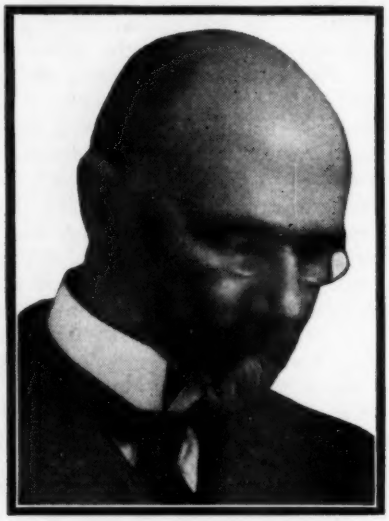
As a clinical observer, his name is attached to two eye symptoms which are of value in the diagnosis of exophthalmic goiter, and which he first described in 1906. In 1898, he reported the first American case of Parinaud's conjunctivitis, a rare condition which had previously been described by only a few observers in France and Austria. He was one of the earliest reporters of the juvenile form of family amaurotic idiocy, and his name has sometimes been associated with this disease.

In therapeutics, probably his most important contribution was the use of large doses of sodium salicylate in sympathetic ophthalmia, which has become the classic treatment of this disease in most countries.

In ophthalmic surgery, he made many important practical modifications of operations described by others, notably in the correction of

ectropion by the use of Thiersch grafts, in the correction of cicatricial entropion by the use of mucous membrane from the lip and in the method of carrying out the Machek operation for ptosis. The procedure of destroying the lachrimal sac with trichloracetic acid as a substitute for the troublesome excision of the sac in dacryocystitis, which has found wide acceptance, was original with him. He devised a form of trachoma forceps for expression of the folds which presents decided practical advantanges over previous instruments, and his brain knife for exploring the brain for brain abscesses, though less known, is a valuable instrument.

His writings have appeared chiefly in the form of articles for the various ophthalmologic journals in this country, England and Germany. His most extensive works are the complete reviews of the subjects of



HAROLD GIFFORD, M.D.
1858-1929

sympathetic ophthalmia in the *American Encyclopedia of Ophthalmology,* and of congenital paresis of the abducens, published in part in the *American Journal of Ophthalmology.* He was one of the editors of the *Ophthalmic Record* during its existence, and on its fusion with other journals into the *American Journal of Ophthalmology,* became a collaborator in that journal.

As an educator, he was one of the founders of the Omaha Medical College, and served that institution as professor of ophthalmology and otology, and for a time as dean of the faculty. He was one of the most interested in the absorption of that school into the Nebraska University College of Medicine in Omaha, and headed the Department of Ophthalmology and Otology in that college when the fusion was effected and until his appointment as emeritus professor.

His purely scientific work was limited in later years by the requirements of a large practice. Into the care of his patients he put not only

exceptional knowledge, clinical judgment and operative skill, but also an intense personal interest. He never allowed personal inconvenience to interfere with anything that might add to a patient's chances. It was not unusual for him personally to see and treat a patient with serpent ulcer three times a day. To those of us who worked with him, one of his most remarkable gifts was the ability to see at once when any condition was not responding to treatment and when a different procedure should be commenced immediately. His knowledge of ophthalmic literature was great, and he continued to read all the important journals of ophthalmology of the world until his death.

Besides his professional work, he found time for a surprising variety of other interests. An early interest in botany and zoology led him to travel extensively and to read all the books about travel and the flora and fauna of strange lands which he could obtain. It was also responsible for his active interest in preserving the natural life and beauty of the woods along the Missouri river. Politically, he was a Socialist and devoted much time to advocating various movements to bring about liberal reforms.

In recognition of his scientific and clinical work, he was granted the honorary degree of M. A. by the University of Michigan and of LL.D. by the University of Nebraska, and was chosen as chairman of the ophthalmological section of the American Medical Association for its meeting in Cleveland.

The passing of Dr. Gifford will be mourned not only by his colleagues and associates, but also by the many to whom as a great physician he was able to bring comfort and hope.

He leaves a widow, two sons (Dr. Sanford R. and Harold, Jr.), and two married daughters.

Harold Gifford recognized the greatness and responsibility of his profession when, after getting his B.Sc. at Cornell and M.D. at Michigan, and after a year of graduate work, he attended four European universities, and took intern and clinical service in New York before starting in his field of special practice. In the forty-three years he gave to that practice, he never lost sight of the responsibility and the duty of the physician to every patient who sought his help.

Understanding the greatness and the incompleteness of medicine, he quickly set to work in original research to test what was uncertain, extend its known facts and improve its methods of giving relief. His constant regard for the interests of each patient won him the respect, confidence and loyalty of patients, nurses, assistants and colleagues, opening wide the gates to professional advancement, influence and honor. How completely he had won the hearts of those who knew him was shown when in 1928 he, an avowed Socialist, received the citation of the American Legion Post, as Omaha's "most valuable citizen." His broad views and benevolence extended to giving grounds to Boy Scouts, refuges for birds, parks to his city, hearty assistance in city planning and a medical school to Omaha, which later merged with the University of Nebraska.

His studies in medicine were not merely efforts to find the thing he started to seek, but exploration of facts before unknown. The negative, he established in regard to etiology of sympathetic ophthalmia, is a basis

for later advances in the theory of that disease. The interest he developed in it led to his demonstration of the value of salicylates in its treatment. He did not hesitate to call attention to the danger from cauterization in prolapse of the iris as he had practiced it. He offered a paper on "The Safest Operation for Senile Cataract," and when he came to read it stated that what he had hoped was the best method was not; he presented what his latest experience indicated were the safer methods.

Dr. Gifford excelled in carefully working out the most efficient and simple means for doing some common operation or making an application. His trachoma forceps were admirably shaped for removing the granules from the caruncle and semilumar fold, the importance of which he understood, although it is not yet generally appreciated. To cauterize the cornea with nitric acid, he suggested the wooden toothpick or match stick using the precaution of allowing the acid to sink into the wood with no fluid left on the surface; this method was so perfectly thought out that thirty years' use of it shows no point in which it can be improved. To apply tincture of iodine to a corneal ulcer, he twisted a fine, but rather stiff, point of absorbent cotton, producing an applicator that for asepsis, delicacy, efficiency and perfect control could not be excelled. Many such suggestions were the subjects of short papers. Others are embodied in longer papers in which they have often been overlooked. In "Notes on Glioma of the Retina" he included suggestions of very practical methods of getting an additional piece of the optic nerve after enucleation, if this seemed desirable, and for destroying the optic nerve into the optic canal. But many of these practical ideas were not published, and were only known to those who had seen him apply them.

Dr. Gifford had a broad interest in biology, which had much to do with some of his original observations of facts that commonly pass unnoticed. This was manifest in his vacation times spent in the Rocky Mountains, in the collection of living plants kept at his home and in the provision he made for a bird refuge on the Missouri River. On his visit to China in 1926, he became much interested in the "Mongolian Eye," and afterward published what is perhaps the best account of it to be found in the literature.

Yet his disposition was always toward the practical application of facts, and the development of the most perfect, yet simple methods of treatment. His destruction of the lacrimal sac by trichloracetic acid has given relief in the hands of many who would not undertake the excision of the sac.

Harold Gifford was one of the men who could not be known wholly by the formal teaching he gave, or by the papers he published. He belongs in a class with Herman Knapp, Marcus Feingold and Alexander Duane. Now that they are gone we wish that we might have seen more of them while they were active in the daily work to which they were devoted.

EDWARD JACKSON.

In the death of Harold Gifford, American ophthalmology has suffered a grievous loss. He was an ardent student, an accomplished research worker, original in thought and technic, a keen observer and an accurate clinician.

A skilful surgeon of excellent judgment, a compelling teacher, a thoughtful author of contributions of lasting value to the literature of the department of special surgery and medicine he so well adorned, he established his reputation as a master ophthalmologist.

As a consultant, his advice was eagerly sought and in perfect trust accepted.

Harold Gifford lived his life abundantly. His patients, his students and his colleagues were and are the beneficiaries of his sterling accomplishments.

He faithfully performed the duties which pertained to organized medicine, and engaged effectively in public and university affairs. He was a citizen of distinction, who was loyal in his relation to civic righteousness and business rectitude.

These words briefly indicate why Harold Gifford became a leader in the profession to which he devoted the best hours of his busy and important life; they indicate also why he was acclaimed as a citizen of eminence.

But he was more than that. He had the gift of friendship, and to be his friend was a real privilege, which I happily enjoyed. Dr. Gifford's range of information, his well-stored and orderly mind, lent a special charm to his conversation and his companionship.

Always ready to help and approve, where assistance and approbation were indicated, he did not hesitate in the application of critical judgment when he believed it was required. This is one of the reasons why Gifford's discussion of scientific papers possessed an unusual value.

On the other hand, he was never reluctant to accept proper criticism, or to correct a printed medical or surgical recommendation of his own should later information or experience have demonstrated that the earlier advice called for modification or withdrawal.

Governed by the courage of his convictions, he not infrequently advanced and maintained opinions with respect to social and governmental problems which were sharply at variance with those commonly held by his neighbors, friends and acquaintances. But they never doubted the honesty of his purpose.

He respected his material, a distinguishing feature in character on which success in life so largely depended. He neither slighted nor shirked his work and his responsibilities.

We deplore the close of his notable and inspiring career, and we shall always remember that he belonged to that group of men in our country who have set an enduring mark on the science and art of ophthalmology.

G. E. DE SCHWEINITZ.

With the passing of Harold Gifford the domain of science has lost one of its best equipped adherents. Although the majority of us are well acquainted with his activities in ophthalmology, only a few intimates are aware of his extensive studies and profound knowledge of natural history, while a more limited circle know of his many contributions to schemes for human betterment.

Forty years of association, especially during field excursions over mountain, stream and forest in California, the West Indies, South America, Ceylon and elsewhere have enabled me to realize the versatility,

the remarkable memory and the catholic reading of the man. Had Gifford cared to do so, he might easily have ranked as an authority on botany or zoology, but he preferred to enjoy rather than to exploit the "spirit of lakes and seas and rivers." His love of wild animals and plant life also converted him into an ardent advocate of the conservation of our vanishing flora and fauna, and it was the chief incentive for the gift of an extensive woodland park to his adopted town. There he took personal charge of the arrangements for preserving native birds, beasts and plants and in encouraging others to enjoy them.

Perhaps the supreme test of Harold Gifford's spiritual status was the regard of his neighbors. Although his passionate belief that the world's tragedies and social inequalities are not inevitable and foreordained but are capable of present-day improvement made him an outspoken Socialist and agnostic, these unpopular theories did not deter the rather orthodox Omaha post of the American Legion from awarding him, in 1928, its civic service citation as "the city's most valuable citizen." And thus, full of honors, our colleague—*integer vitae*—has crossed into the unknown. His memory will be happily preserved by many thousands of admirers that survive him.

CASEY A. WOOD.

Abstracts from Current Literature

EDITED BY DR. WILLIAM ZENTMAYER

Physiology

THE MEANING OF EHRLICH'S FLUORESCEIN EXPERIMENT. E. HERTEL, Arch. f. Augenh. **100-101**:460, 1929.

In order to understand the mechanism of the appearance of the Ehrlich line in the unopened eye, Hertel points out the necessity of increasing the normal rate of the movement of fluid through the anterior chamber. The following experiments were performed with this in view.

1. Fluorescein experiments combined with injection of sodium chloride: In a series of rabbits, 1 cc. of 10 per cent sodium fluorescein per kilogram of body weight was injected intravenously. Within two or three minutes the usual Ehrlich line was visible in the anterior chamber. An intravenous injection was then made of different concentrations of salt at the rate of 10 cc. per kilogram of body weight per minute. In the animals which received an injection of 10 per cent salt solution the Ehrlich line disappeared in about two minutes. Whereas control animals who received no salt solution still showed a well marked line up to forty minutes.

In other animals the salt solution was administered first, and after the tension of the eye had fallen the fluorescein was injected. When this was done while the intra-ocular pressure was still about 10 or 12 mm. of mercury, the fluorescein appeared in the anterior chamber as a diffuse cloud, and only when the pressure had reached from 20 to 22 mm. was there a definite Ehrlich line.

2. The fluorescein experiment combined with an intravenous injection of gelatin: A rabbit was given 0.25 Gm. of fluorescein per kilogram of body weight by intravenous injection. After the Ehrlich line had appeared in the anterior chamber, 100 cc. of a 10 per cent solution of gelatin was injected intravenously. No change appeared until after ten minutes; then the line gradually decreased in size, and disappeared in about forty minutes. The tension, however, had decreased materially. In a control animal which received the fluorescein but no gelatin tension was normal and the line lasted for forty minutes. At the end of forty-five minutes the anterior chambers of both animals were tapped and the fluorescein content was determined colorimetrically. The rabbit that had been given the gelatin had a concentration of fluorescein of 1:300,000; the control animal showed a concentration of 1:120,000. Other animals were given the gelatin first, followed by the fluorescein; in these no Ehrlich line appeared.

Both sets of experiments showed, therefore, the same results; i. e., a marked change in the rate of fluid movement in the eye, as evidenced by the change in intra-ocular pressure, and a marked influence on the movement of fluorescein as evidenced by the change in the character of the Ehrlich line and in the colorimetric values.

A removal of fluid from the eye diminished the amount of fluorescein and, increasing the amount of fluid in the eye, led to an increase in the amount of fluorescein.

In the gelatin experiments the fluorescein appeared to be influenced, with no change in pressure, but this is explained by the increased absorption of the fluorescein by the added colloids to the blood. This prevented the appearance of the fluorescein in the anterior chamber by retaining it in the blood stream.

These experiments show, therefore, that the movement of fluid in the eye and the appearance of fluorescein go hand in hand; histologic preparations of these eyes showed the blood vessels of the iris and ciliary body filled with the dye, whereas the ciliary epithelium remained unstained. The passage of the dye, therefore, between blood and aqueous takes place directly through the blood vessel wall; a passage through the ciliary epithelium can be excluded. Since dye and fluid exchange are synchronous, it can be said that fluid formation in the eye also is concerned only with the passage through the vessel wall, and no evidence is seen of the intermediation of the ciliary epithelium in the formation of aqueous.

F. H. ADLER.

THE INTERCHANGE BETWEEN BLOOD AND AQUEOUS. YOSHIHARA YOSHIDA, Arch. f. Augenh. **100-101**:470, 1929.

A number of investigators have pointed out that the concentration of fluorescein in an ultrafiltrate such as aqueous depends on the amount of free fluorescein circulating in the blood and not on the total amount of dye in the blood stream. The reason for this is that a certain proportion of the dye is absorbed by the blood colloids and hence is not free to diffuse through the walls of the capillaries. The present experiments were undertaken to prove this point.

An intravenous injection of 0.25 Gm. of sodium fluorescein per kilogram of body weight was given to a series of rabbits. Blood was withdrawn from the external jugular vein, and samples of aqueous and vitreous were taken for the analysis of the concentration of fluorescein. In each animal only two estimations of the concentration in blood, aqueous and vitreous were made. At the same time, a sample of urine was collected and similarly analyzed. The determination of the concentration of fluorescein was made with a modified Duboscq colorimeter. The time of withdrawal of the fluids after the injection of the dye varied from one to twenty-six hours. The results of these experiments showed that the percentage of fluorescein in blood serum is always much higher than that of aqueous and vitreous, whereas the concentration in urine is considerably greater than that of the blood serum. The gradual decrease in concentration of dye in aqueous and vitreous runs parallel to that of blood serum. The concentration in the urine, however, does not parallel that of the serum.

In another series of experiments samples of blood serum were withdrawn and put in ultrafilter and an analysis was made of the concentration of dye in the ultrafiltrates so obtained. A comparison of the percentage of dye in the ultrafiltrate with that in samples of aqueous humor withdrawn simultaneously with the blood showed an extremely close similarity. Within the limits of experimental error, therefore, the author concludes that the passage of fluorescein from the blood into the aqueous follows definite physiochemical laws.

F. H. ADLER.

Vision

A Mode of Recording the Eye Movements in Reading. A. Antonibon, Ann. di ottal. e clin. ocul. **57**:673 (Aug.-Sept.) 1929.

The author applies to the upper lid a small air-tight rubber drum which is connected by tubing to a second drum provided with a pen writing on smoked paper. The smallest ocular movements change the pressure in the drum and are recorded. Reading is accomplished by a series of slight movements, alternating with periods of repose which are seen as horizontal lines. Changing from one line to the next produces more extensive vertical steps in the graph. Ordinarily, the eyes fix the first letters of a word, passing quickly over the latter part, which is shown in the graphs. When reading a foreign language, the latter part of the words are also fixed, as is shown by the greater number of steps in the graph. Persons not accustomed to reading furnish a similar record when reading their own language. The graph of an educated person reading poetry shows a rhythmic scanning with only three or four steps for every line (five graphs).

S. R. Gifford.

The Monocular Perception of Relief and Its Consequences. E. Carlo, Ann. d'ocul. **166**:650 (Aug.) 1929.

The perception of the third dimension is distinctly a matter of education of vision by the faculties of touch and motion.

In the first place, our intelligence has learned by touch how to interpret elevations and depressions of an object, which our vision has simply shown to be differently interpreted.

In the second place, that which we have learned has taught us that an object of known dimensions appears smaller to us the further away it is.

The author says that monocular vision is a complete vision, but less plain and distinct than binocular vision.

The perception of relief, obtained by binocular observation of four conjugate images, is less defined than the relief obtained by monocular vision of two conjugate images.

A man who loses an eye continues to see, but one who loses a leg is a cripple, because he cannot move about normally. Therefore, the former is incapacitated to a lesser degree.

H. W. Scarlett.

Methods of Examination

A Method of Mapping Scotomata with Tangent Screen by Binocular Fixation. A. Cowan and M. E. Marcove, Am. J. Ophth. **12**:651 (Aug.) 1929.

By means of a mirror set at an angle of 45 degrees the eye not being examined maintains fixation by looking at an object placed at the side of the patient which is equidistant from the eye as the tangent screen is from the examined eye. By adjusting the mirror to the proper angle this fixation object (a cross) can be fused with the object (the letter O) on the tangent screen.

W. S. Reese.

Lacrimal Apparatus

TUBERCULOUS DACRYO-ADENITIS. M. P. MOTTO and E. H. ROWEN, Am. J. Ophth. **12**:818 (Oct.) 1929.

The authors speak of the rarity of this disease and cite the case of a colored boy, aged 8, who complained of poor vision in and inability to close the left eye. When 6 years of age, he had measles, and a few weeks after returning to school a tuberculous spine was discovered. He was placed on a Bradford frame and sent to a fresh air camp, where a swelling of the right elbow and of the outer half of the left upper lid developed. Examination showed ectropion of the left upper lid, especially temporally, apparently due to connective tissue changes. What appeared to be redundant conjunctiva projected about 1 cm. below the outer one third of the margin of the lid. The cornea showed several opacities, and vision was $\frac{2}{60}$. A tentative diagnosis of inflammatory tumor, probably tuberculous, was made. Two plastic operations were done which gave a fair result, and later the tumor mass was excised. The pathologic diagnosis was tuberculous dacryo-adenitis.

W. S. REESE.

Cornea and Sclera

OBSERVATIONS ON CORNEAL OPACITY IN SCLEROSING KERATITIS. P. SCOTTI, Ann. di ottal. e clin. ocul. **57**:661 (Aug.-Sept.) 1929.

The author reports four cases in which the behavior of the corneal opacity was carefully followed. In the first three, the opacity corresponded with an area of scleritis, being wedge-shaped, with the base at the limbus and the apex toward the center of the cornea. In one case no scleritis was present, the opacity being located near the center of the cornea and surrounded by clear corneal tissue. As the opacities cleared, several smaller zones of infiltration were left. The scars of a previous sclerosing keratitis confirmed the diagnosis in this case. The author believes this form of infiltration in the cornea itself, without the presence of scleritis, has not been sufficiently emphasized. (Bibliography.)

S. R. GIFFORD.

THE PATHOGENESIS OF INTERSTITIAL KERATITIS AND ITS RELATIONS TO THE ENDOCRINE GLANDS. B. G. TOWBIN and B. M. PROSOROWSKI, Arch. f. Ophth. **122**:257 (July) 1929.

Among the many patients who have congenital syphilis, only a few develop interstitial keratitis. Therefore, the authors conclude, there must be some other etiologic factors present besides the hereditary syphilis. Among these factors, disturbances of the endocrine glands play an important rôle. The authors examined twenty cases of interstitial keratitis and found in practically every case symptoms which indicated disturbances of the endocrine system. The authors believe that these endocrine anomalies are the result of a syphilitic degeneration ("intoxication") of the endocrine glands. This degeneration changes the permeability of all the tissues and of the separating membranes. Thus, the toxins or the spirochete can easily enter the tissues, and in the case of the interstitial keratitis, the cornea. In other words, the normal

function of the endocrine glands leads to a certain amount of impermeability of the tissues, so that they become more or less inaccessible for the syphilitic toxins. If the hereditary syphilis has caused severe anatomic or functional changes of the whole endocrine system, then the cornea is much more exposed to the syphilitc virus and its toxins.

P. C. KRONFELD.

Lens

THE GAS METABOLISM OF THE LENS. E. SCHMERL, Arch. f. Ophth. **122**:488 (July) 1929.

In a previous paper, the author found that the normal clear lens of the rabbit had an oxygen consumption of 4 c. mm. per hour. If the capsule of the lens was injured, the oxygen consumption was markedly increased (usually twice as high as normally). In early stages of naphthalin cataract, the respiration of the lens was found to be between 7 and 20 c. mm. per hour. In the present paper, the author gives some figures on the respiration of cataractous lenses of rabbits in which the cataract was caused by x-rays. These lenses (adult rabbits) showed clinically the typical posterior cortical cataract. When studied after the method of Warburg, the lenses showed a slightly increased oxygen consumption, too. The author believes that the beginning stages of every kind of lesions of the lens are characterized by an increased oxygen consumption.

P. C. KRONFELD.

OBSERVATIONS ON LESIONS OF THE HUMAN LENS CAUSED BY ROENTGEN AND RADIUM RAYS. A. MEESMANN, Klin. Monatsbl. f. Augenh. **81**:259 (Aug.-Sept.) 1928.

After referring to the publications of Rohrscheider (Roentgen Cataract, Its Origin and Morphology, *Klin. Monatsbl. f. Augenh.* **81**:254 [Aug.-Sept.] 1928) the author adds the following personal clinical observations.

CASE 1.—A man, aged 21, had a fibroma removed from the nasopharynx in 1921. This operation was followed by two deep roentgen-ray treatments, one in the spring and the other in the fall of the same year. The eyes were completely protected each time. This precaution was omitted on the occasion of two later treatments at another hospital during the summer of 1922. The lids of both eyes became reddened and swollen. Diffuse erythema of the nose and cheeks was noticed shortly afterward. The patient therefore refused a third treatment. All these symptoms disappeared within a few weeks. During the winter of 1922, however, there were indications of decreasing vision, which became constantly more evident until the winter of 1926; then the vision remained stationary. Both eyes showed ampulla shaped dilatations of the vessels at the limbus, typical in lesions caused by roentgen rays, and disklike opacities on the posterior poles of the lenses; the eyes were free from other changes. Examination with the slit lamp showed that these disks consisted of minute dots and fibers, prominent anteriorly in the shape of an obtuse, convex arc, and sharply defined from the normal cortex. The base of the opacity was adjacent to the posterior capsule, suggesting its subcapsular origin. The demarcation of the hyaloid membrane could not be definitely distinguished. No relation

between the hyaloid membrane and the opacity could be established. Isolated subcapsular dots and fibers, similar to those mentioned, were found also in the periphery of the opacity. About two thirds of both lenses was clear, except for fine opacities scattered below the anterior capsules. These, examined by means of the diaphragm beam, appeared to be a multitude of minute subcapsular vacuoles, some of them confluent. A few crystals, apparently cholesterol, were present. The lenses were more opalescent than usual. The lesion of the capsular lamellae frequently found in glass-blower's cataract was not seen. Vision in each eye was 1/35. The cataracts were successfully removed. The changes at the posterior poles were found to be similar to those in ultrared cataracts in every respect.

The author considers the ray cataract an exogenic cataract. In his opinion, the lesion of the lens is due to some hitherto unknown disturbance of the metabolism of the lens. The beginning of a cataract at the posterior pole is found, also, in so-called complicated cataract (coupled with iritis, detachment of the retina, etc.). He considers that there is no possibility of a connection with the hyaloid canal. Furthermore, it is similar to other exogenic cataracts of the type of diabetic, electric and contusion cataracts (illustrated in Meesmann's Slit Lamp Atlas, pictures 172, 175, 176, 184, 185 and 118).

He favors the view that the droplets, or vacuoles, may be caused by a chemical change of the lens fibers, freeing the water, according to Vogt (myelin droplets), rather than the view that they are caused by aqueous humor penetrating the lens capsule. This idea is supported by the presence of cholesterol crystals, a product of the lens albumin, which is no longer able to retain the normal amount of cholesterol in liquid form.

The opacities at the posterior pole differ from those in typical complicated cataracts. They are well defined from the normal cortex, and they progress concentrically, preserving a distinct demarcation; while the progress of the complicated type is irregular.

Case 2.—A printer, aged 27, was first seen in June, 1927. His right eye was normal; the left showed extensive scars of the lids and of the lower portion of the conjunctiva and, also, ampulla shaped dilatation of the vessels. The cornea was not involved. Extensive opacities of the type found with ray cataract formed a large, flat dulness at the posterior pole, slightly prominent anteriorly and extending into the intermediate zone, whence subcapsular opacities of less density stretched almost to the equator. Fine subcapsular vacuoles were scattered sparingly on the anterior surface of the lens, where there was also a broad subcapsular opacity, bearing perpendicular sectors, which extended almost to the anterior pole. Vision was 1/5.

In October, 1918, lead dust had caused in this eye a lesion of the conjunctiva which resisted local treatment for a long time; flat granulations and ulcerations formed. A whitish and readily removable deposit was seen extending from the margin of the lid into the conjunctiva bulbi; symblepharon and entropion were present. Nothing was found by microscopic examination or culture. The patient was treated with radium twice, for three hours each time, with eversion of the lid and fixation with a suture. The reaction had disappeared twenty-four hours later. Vision was 6/6 on the day of his discharge. One half year

after these radium treatments, his vision began to diminish and remained stationary early in 1920; it was 1/20 in June, 1927.

The slit lamp revealed a picture resembling a ray cataract, but more extensive. The area on and beneath the anterior capsule represented the area affected by direct emanation of the radium rays. The changes at the posterior pole, however, could not have been produced by direct ray energy, nor could the beginning of the formation of the cataract be sought here, as in the case of roentgen-ray cataracts. Nothing is known with reference to the dose of the exposures.

Two more cases of lesions of the lens attributed to treatments with the roentgen rays are recorded. They were observed in a series of thirty-six cases of lupus in the neighborhood of the eyes. The ages of the patients ranged between 12 and 75 years. The duration of their treatments varied between six months and thirty-two years. It was found, incidentally, during the examination of these patients, that Finsen rays had no ill effect on the eyes, although some of these persons received treatments on their lids or the immediate vicinity, aggregating 300 hours.

CASE 3.—A girl, aged 17, with lupus of the nose and the left lower lid of twelve years' standing, was treated with various rays repeatedly during that period; with roentgen rays, applied to the nose and lid several times during the first years of her sickness, with Finsen light for the last five years and with the Kromayer lamp once only. Her right eye showed a small subcapsular opacity on the posterior pole, distinctly independent from the area of the hyaloid canal. This opacity was composed of fine dots and fibers, and it was sharply defined from the normal cortex. Other changes of the lens, or of the globe itself, and changes of the blood vessels were not seen. In the right eye, the vision was 5/10. After ruling out congenital and complicated cataracts and also the effects of the Kromayer and the Finsen rays, the author holds the roentgen rays responsible for the changes in the lens.

CASE 4.—A woman, aged 57, had suffered from lupus of the face and the right upper lid since the fifth year of her life. The lupus was most severe when she was about 40 years of age. The skin was practically normal, after treatments with various kinds of rays. The right lens was normal. The left lens showed changes at the posterior pole, analogous to those seen in the preceding case, but less extensive. Vision was normal. The diagnosis was the same, as in the first case, regarding the lesion of the lens.

All the other patients had clear lenses; almost all had been treated with Finsen rays, two of them with roentgen rays and sixteen with the Kromayer lamp, as often as twenty-five times in some instances. This would allow, in the author's opinion, the conclusion that the quartz rays do not cause lesions of the lens.

Résumé.—Roentgen-ray and radium-ray cataracts begin exactly at the posterior pole of the lens, independently from the location of the hyaloid canal. The location of the lesion cannot be explained by direct action of the rays. It is an indirect action analogous to that which causes the polar opacities of ultrared cataracts. The subtle subcapsular vacuoles (or myelin droplets) and the fine, diffused opacities of the outer lens portions are caused by the same indirect influence. Lesions of the lens capsule, the epithelium and the adjacent cortex may be due

to direct action only in patients who have received large doses of rays, especially of radium. Ray cataracts are exogenic cataracts. Unlike the diabetic, the electric and other exogenic cataracts, the ray cataracts begin at the posterior pole of the lens. Their location is similar to that of the complicated cataract, but the opacity differs from it in appearance and in the manner of its progress. K. L. STOLL.

BLOOD SUGAR IN PATIENTS WITH CATARACT. K. MEHLHOSE, Klin. Monatsbl. f. Augenh. **83**:97 (July) 1929.

Research on the quantity of blood sugar in patients with cataract shows various results. Malkin and Krassikov found hyperglycemia in from 35.7 to 57.9 per cent of people with various types of senile cataracts. The percentage of those with hyperglycemia increased in proportion to the opacification of the lenses. The blood sugar tests were made from three to four hours after admission to the hospital. Baldwin and Barthel found more than 0.12 Gm. of blood sugar per hundred cubic centimeters of blood in 75 per cent of 132 patients with cataracts. Langdon, on the other hand, found hyperglycemia in only seventeen of 100 patients with senile cataracts, or in 15 per cent; forty-five of these had lessened tolerance for sugar. The figures of O'Brien and Myers were still lower—three of 54 patients, or 5.5 per cent.

The author reports the results obtained in a group of fifty patients with cataract whose urine was free from sugar on admission, who were examined for blood sugar. Their ages ranged between 34 and 79; 31 were men and 19 women. A modification of the Bang test for blood sugar was employed. An average of 0.078 Gm. per hundred cubic centimeters was found; an amount greater than 0.12 Gm. per hundred cubic centimeters was present in only three patients, or in 6 per cent of those persons who were free from diabetes. The tolerance test for grape sugar was made in ten of these patients by giving 50 Gm. dissolved in coffee, on an empty stomach; samples of the blood were taken one-half and two hours later. Their average of 0.069 Gm. per hundred cubic centimeters increased to 0.13 and returned to 0.061. This experience would suggest that a diminished tolerance in this type of patient is at least rare. It cannot be of consequence in the development of senile cataract. Antidiabetic diet would hardly be instrumental in retarding or stopping the growth of the senile cataract.

K. L. STOLL.

Uvea

DEAFNESS, BALDNESS AND GRAYNESS OF THE HAIR IN SEVERE BILATERAL UVEITIS OF SYMPATHETIC AND OTHER ORIGIN. F. J. SORIANO, Arch. de oftalm. de Buenos Aires **4**:557 (Sept.) 1929.

The author, after mentioning the frequent occurrence of deafness, baldness and grayness of the hair in connection with sympathetic ophthalmia, refers at length to a paper by Koyanagi in the February issue of *Klinische Monatsblätter für Augenheilkunde* on "Disacusia Alopecia and Poliosis of Nontraumatic Origin," in which the latter, after referring to recent anaphylactic theories and to Adogué's theory of a nervous sympathetic origin, considers the explanations unsatisfactory and refers to six of his own case and sixteen of other authors' in which these

complications occur in nontraumatic cases. According to Koyanagi, they occur mostly in persons between 30 and 40 years of age; the disease commences with a neuroretinitis, which develops into a diffuse choroiditis and later into an iridocyclitis, in a few cases complicated with a retinal detachment. In cases terminating favorably, after a clearing of the media, a diffusely depigmented fundus without pigment migration is found. In 50 per cent of the cases there is acoustic trouble (tinnitus, deafness and nystagmus), which presents itself almost at the same time as the eye trouble, and as a rule is of short duration. The symptoms connected with the pilous system usually appeared from two to three weeks after the eye symptoms; Koyanagi considered that they started earlier but were not usually recognized at first. The turning of the hair gray occurs after the alopecia has lasted for some time, and in some cases it was preceded by plaques of vitiligo; he does not consider these manifestations as produced by the uveitis but due to a common (hitherto unknown) cause.

The author finally refers to a case of his own occurring in a woman, aged 28, who after a traumatism of the right eye, with a subconjunctival rupture of the sclera, incarceration of the ciliary body, intra-ocular hemorrhage and total loss of sight, presented, after one and one-half months, a sympathetic iritis of the left eye, accompanied by deafness. The right eye was enucleated, the sympathetic symptoms of the left being brought to a standstill, with preservation of useful vision and improvement of the auditory condition.

C. E. FINLAY.

Glaucoma

SOME NON-SURGICAL AIDS IN THE TREATMENT OF GLAUCOMA. S. R. GIFFORD, Brit. J. Ophth. **13**:481 (Oct.) 1929.

The author begins his paper with the statement of his belief that nearly all cases of glaucoma will sooner or later require surgical intervention. It has been his experience to see many more bad results from postponing this intervention than from unsuccessful operations. It goes without saying that the miotics, eserine and pilocarpine, should be tried in most cases before anything else is done. The great danger of miotics is overconfidence in their effect. The cutting down of the field should not be ordinarily considered a contraindication to operation. The loss of field following operation can be rendered exceedingly rare by reducing the tension to as near normal before the operation as possible and by minimizing the time during which the anterior chamber remains empty following operation in which respect iridencleisis with running conjunctival suture presents advantages over trephining.

Of about 100 treatments with epinephrine, the records of 50 are complete enough to be of any value. In most cases the ordinary 1:1,000 solution of epinephrine was used. In two thirds of these the pack was used (a pledget of cotton on which the drug has been dropped, placed under the upper lid). In 15 cases the treatment failed to produce an appreciable decrease of tension. These were: iritis glaucomatosa, 2; inflammatory glaucoma, 2; absolute, 1; secondary, 1; acute, 1 and simple, 9. In all others, most of which were cases of simple glaucoma, there was an average decrease of 10 mm.

In all but 3 cases tension reached normal or below 25 mm. (Schiötz). In simple glaucoma an acute rise of tension without permanent ill effects occurred in two cases. Aminoglaucosan (an epinephrine substitute) was tried, but such a severe inflammation followed its use in one case that no further trial of it was made. Ergotamine was used in 11 cases. Five were in cases after cataract operation; 3 were glaucoma in sympathetic ophthalmitis, 2 were of simple glaucoma and 1 was of absolute glaucoma. In one of the simple cases of glaucoma in which eserine and epinephrine had lost their effect, not enough effect was produced to avoid operation. In the other case in which tension varied greatly from other factors, tension was reduced from 37 to 11 mm.

Gifford's conclusions are:

1. Epinephrine or glaucosan (an epinephrine substitute) is of value especially in simple glaucoma, and by its means tension may be kept normal for considerable periods in certain cases.

2. Miotics should be used to prevent acute rise of tension when epinephrine is being used and to prolong its effect afterward.

3. Aminoglaucosan presents the danger of increasing inflammation and fails to reduce tension in many cases.

4. Hypertonic solutions can be depended on to reduce tension before operation in acute glaucoma, and are without danger to the eye.

5. Ergotamine will reduce tension appreciably, it may be of much value in a small percentage of cases, and it may be tried safely in any case.

6. All methods of treatment demand careful watch of the visual fields and tension, so that progress of the disease may be noted early enough for effective surgical intervention.

W. ZENTMAYER.

SYPHILITIC PATIENTS WITH GLAUCOMA. C. ESPÍLDORA LUQUE, Arch. de oftalm. hisp. am. **30**:545 (Sept.) 1929.

This is the fourth of a series of papers based on investigations on the general health of 300 patients with glaucoma, carried out in Charlin's Clinic in Chile during the last ten years.

In this paper, the author considers the proportion of syphilis found in these patients as having a direct etiologic significance.

In this series, he was able to determine undoubted syphilis in 40 per cent of the cases (119), which in relation with the different age groups is to be found in 60 per cent of the juvenile, in 48 per cent of the adult and presenile and in 24 per cent of the senile groups.

Exceptionally, these cases of syphilitic glaucoma are found independent of any organic vascular lesion, syphilis being determined by a positive Wassermann reaction. This occurred in only 11 of the 119 cases, of which 1 (1.1 per cent) belonged to the juvenile, 9 (9 per cent) to the adult and presenile and 1 (1.1 per cent) to the senile groups.

Fifty-nine cases of the remainder, with a positive Wassermann reaction, presented organic, mostly vascular lesions: aortitis with or without valvular lesions, arterial hypertension, peripheric sclerosis and aortic atheroma.

In forty-nine additional cases, notwithstanding a negative Wassermann reaction, the existence of syphilis was determined by the presence

of cardio-aortic lesions, of clear syphilitic stigmas, by means of the patient's history or by the result of a treatment with mercury.

As regards the variety of glaucoma, he finds that of 59 acute cases, 34 (57.6 per cent) were in syphilitic patients. In the chronic cases, 245, syphilis was determined in only 85 (35.2 per cent).

The author considers that the etiologic importance of syphilis in relation to glaucoma can be determined by studying its frequency in patients with glaucoma and by observing the effects of an antisyphilitic treatment independent of any local or surgical measures. In connection with the first, he refers to the present statistics, and as regards the second, he reports two cases of Charlin's of acute glaucoma in which satisfactory treatment was given solely by antisyphilitic measures. He also reports four cases of chronic glaucoma in which benefit was apparently obtained by antisyphilitic treatment in combination with other measures.

C. E. FINLAY.

Retina; Optic Nerve

CIRCINATE RETINITIS: REPORT OF A CASE. H. W. SCARLETT, Am. J. Ophth. **12**:633 (Aug.) 1929.

When the patient was first examined on March 2, 1928, the left eye presented two hemorrhages to the temporal side of the disk. Near the latter, and extending above and below the sweep of the superior and inferior macular vessels, were a few discrete, whitish-brown dots forming a crescent. Further distant from the disk, below the inferior macular vessel, were two confluent patches of exudate.

On Oct. 19, 1928, all traces of hemorrhage had disappeared. Starting from the upper and lower temporal edges of the disk, in a crescentic fashion, were several discrete and confluent dots, more marked below and extending down and out to a point beyond the macula, and then upward to a level with the upper border of the macula, forming an incomplete ring of serrated exudate around the lower and temporal sides. The exudate was thicker at this side, and the crescent was fringed in spots by pigment.

In the center of the macular region there was an irregular, round, yellowish-red area surrounded by a large whitish mass. The vessels of the fundus were markedly sclerosed.

W. S. REESE.

Neurology

CEREBRAL TUMORS. H. S. SOUTTAR, Brit. Med. J. **1**: 53 (Jan. 12) 1929.

In speaking of the tumors of the brain which interfere with vision, the writer describes the optic pathways, and discusses the optic radiations which loop around the descending horn of the lateral ventricles to reach their destination in the occipital cortex. The optic radiations throughout their course are arranged so that the upper fibers receive impulses from upper portions of the retina, the lower from the lower. In tumors of the occipital lobe, generally the whole visual area is involved with loss of vision in the contralateral visual field. The visual disturbances are irritative or paralytic. The former are more likely to be produced by cortical tumors and appear as flashes of light, often

colored like fireworks. The deeper tumors gradually produce a contraction of the contralateral field best shown by small test objects. The superficial tumors tend to extend forward over the cortex and to involve the lower sensorimotor areas, producing numbness in the opposite face or hand. The deep tumors tend to involve the posterior part of the internal capsule, producing sensory changes in the opposite half of the body and paresis in the opposite leg. Cushing has drawn attention to an interesting syndrome in which the optic radiations are affected in the posterior part of the temporal lobe. Owing to the arrangement of the optic reactions in reference to the retina, tumors in the lower part of the right temporal lobe will affect the upper visual field; and the left upper quadrant will be blind; a left upper quadrantic homonymous hemianopia results. These quadrantic hemianopsias are usually incomplete and hence overlooked. They can, however, be found in the early stage, as later they merge into a complete hemianopia.

If the uncus is involved, peculiar attacks with hallucinations of smell, taste, hearing or vision may result. The hallucinations of vision are curious and form definite pictures—a row of black cats or a little figure—thus contrasting with visual disturbances seen in tumors of the occipital lobe. These pictures are always the same and are always in the blind portion of the field. The combination of quadrantic hemianopia with uncinate attacks sharply distinguish tumors in the temporal lobe.

A. KNAPP.

CONTRIBUTIONS TO DIAGNOSIS AND THERAPY OF PITUITARY TUMORS. J. HAMANN, Ztschr. f. Augenh. **68**:317, 1929.

From a study of cases of hypophyseal tumor and a survey of the literature, Hamann concludes that it is necessary to consider the roentgenogram, the ocular disturbance and the duration of the illness before determining the method of intervention. Two procedures are used: surgical and light ray therapy. He notes that when the tumor involves the pituitary body with encroachment on the surrounding bony tissue it is best treated with light rays; when the bony tissue, however, is involved and the tumor mass breaks into the sphenoidal sinus and there is a decrease in the visual acuity and peripheral visual fields, surgical intervention should be resorted to. In the latter instance, favorable results will be procured if the mass is not too large and is confined to the sphenoidal sinus. Treatment with roentgen rays or radium before and after the surgical removal is also advised for in no case can one be sure of the extent of distribution of the tumor tissue. Often the cells are not completely destroyed by surgical treatment, so that the capsule which is frequently formed about the tumor tissue prevents further dissemination of the malignant cells.

He concludes that radium and roentgen therapy has an advantage over surgical procedures with their high mortality. Even in advanced cases this procedure has checked the condition and frequently caused improvement. He also finds that a choked disk often signifies that the process is not a primary pituitary tumor but a tumor of the infundibulum or at the base of the third ventricle or a pituitary tumor with an accompanying internal hydrocephalus. A malignant condition

of the pituitary gland is most frequently unaccompanied by acromegaly. It is shown that the severity is greater in cases that are not acromegalic.

A. M. YUDKIN.

Ocular Muscles

DIVERGENCE EXCESS: ITS FREQUENCY; ITS CORRELATION WITH REFRACTION; AND THE VALUE OF ORTHOPTIC TREATMENT. C. BERENS, LE G. H. HARDY AND E. STARCK, Am. J. Ophth. **12:** 793 (Oct.) 1929.

A review of the literature revealed wide variance of opinion as to the frequency of divergence excess, its correlation with refractive errors and its treatment. Eleven thousand cases were reviewed. Six tables are given showing the variations in opinions of different authors, the age incidence, correlation with refraction, results of treatment, etc. The following conclusions were made: 1. Divergence excess occurs in the private practice of ophthalmology (in New York City) in from 1 to 2 per cent of all cases. 2. It is not correlated with refraction. 3. Orthoptic treatment is frequently of value, and in some cases obviates operation. It should be tried in every case primarily, and in those cases requiring surgical measures it should be continued as an adjuvant to insure the best possible treatment.

W. S. REESE.

THE RÔLE OF UNLEVEL ORBITS IN HETEROPHORIA. A. L. BROWN, Am. J. Ophth. **12:** 815 (Oct.) 1929.

The author believes that the symptoms that patients with unlevel orbits exhibit are usually due to the cyclophoria resulting when they look at near objects. Some of these patients reveal hyperphoria in the lower eye which turns to hypophoria after five days of continuous occlusion. These patients seem to have the severest symptoms, suggesting that this pseudohyperphoria is spastic in type. The muscle balance of these cases varies from time to time. Fifty cases were studied, in all of which one orbit was at least 5 mm. higher than its fellow. At the first examination, 50 per cent showed hyperphoria of the higher eye; 20 per cent showed hyperphoria of the lower eye, and 30 per cent showed orthophoria. These patients were refracted under homatropine, and one eye occluded for five days. Eighty-five per cent showed relief from symptoms; 96 per cent now showed hyperphoria of the higher eye. A full correction of the hyperphoria was never given at first. A postcycloplegic test followed by a muscle test was considered the criterion for correction. At the first examination, when Maddox rods were placed over both eyes, the 50 per cent testing hyperphoria saw practically parallel horizontal lines at 20 feet. At 14 inches, however, the higher eye saw the line tilted with its nasal half higher. This tilting became less or disappeared when the hyperphoria was corrected.

W. S. REESE.

A CASE OF ISOLATED INTRINSIC OPHTHALMOPLEGIA. A. FAVORY, Arch. d'opht. **46:**257 (May) 1929.

Favory makes a case report the basis for the description of the subjective and objective symptoms of this condition, and for a discussion

of its etiology, its prognosis and its localizing value. He divided the cases into two groups: (1) the isolated cases in which the pupil and accommodation alone are affected, and (2) those cases in which other muscles are involved—the associated cases. He then takes up in detail the etiologic possibilities with reference to the isolated cases. Mydriatics, bilateral glaucoma, injuries to the orbit and the head, acute infections, alcoholism, mushroom poisoning and diabetes are mentioned. Considerable stress is laid on syphilis, both congenital and acquired. When syphilis has been ruled out, tumors, vascular conditions and meningitis can be considered. The author thinks the prognosis is serious in the majority of cases. The site of the lesion is discussed.

S. B. MARLOW.

VOLUNTARY UNILATERAL MOVEMENTS OF THE EYES. E. ADROGUÉ & R. F. PEREIRA, Arch.de oftalm. de Buenos Aires **4:** 419 (July) 1929.

The authors report two cases of dissociation of parallelism or convergence, in which the visual acuity of each eye was normal and in which binocular and stereoscopic vision was unaltered.

In the first case, the patient, with eyes fixed at a distance, could ad libitum direct his left eye outward while the right remained fixed. In the second case, with both eyes in convergence or looking at a distance, the patient could voluntarily move either eye inward or outward, while the other remained fixed.

After a brief review of the literature on the subject, the author, in partial agreement with Bielschowsky, concludes: 1. In the production of ocular reflexes a unilateral or bilateral innervation may exist in place of a simultaneous innervation of both eyes. 2. In the majority of cases of dissociation, the eye in which the visual field has been eliminated is the one that deviates, taking the anatomic position of rest (divergence). 3. It is necessary to accept an independent innervation from the subcortical centers, one for each side, although closely related. 4. The origin of the dissociation must be looked for, according to Bielschowsky, in lesions which impede the simultaneous fixation of a given object.

C. E. FINLAY.

PARINAUD'S SYNDROME. H. SCHAEFFER and J. BLUM, Arch. d'opht. **46:** 351 (June) 1929.

The authors point out that although paralysis of associated vertical movements is well known clinically, the anatomic site of the lesion and the pathology capable of explaining it still remain uncertain. Paralysis of associated movement upward has been noted more frequently than paralysis of associated movement downward, although the latter is not exceptional. Complete loss of all vertical movement may be found. In examining these cases, an attempt should be made to discriminate between voluntary and involuntary movements. The necessary procedures are discussed. Although paralysis of the vertical movements may be isolated, other neurologic signs are more commonly present. In discussing the anatomic site of the lesion, they point out not only the variety of locations where lesions have been found in the cases examined but also that the superior colliculi have been intact in several reported cases. After reviewing the theories proposed to explain this

condition, they suggest that the site of the lesion will vary depending on whether the voluntary, associated or automatic movements are lost. The anatomic evidence is too inexact to allow a definite localization, but the large number of observations reported seems to indicate that the lesion is probably situated near the oculomotor nucleus.

S. B. MARLOW.

Orbit, Eyeball and Accessory Sinuses

CAVERNOUS SINUS THROMBOSIS WITH RECOVERY. E. A. SEALE, Brit. M. J. **1:** 1155 (June 29) 1929.

After her last confinement, which was severe, the patient, aged 30, experienced pain in her left eye, with headache. The eye became red and very large, and pain was also felt behind the left ear. After this condition had persisted for some months, the right eye went through similar changes, while the swelling of the left eye decreased. When the patient was examined the right eye was proptosed straight forward; there was chemosis; the cornea was dull and the pupil was semidilated and rigid. The tension was soft, the disk pale and the field contracted. The vision was 2/60. Vision in the left eye was 6/24. It deviated up and out, and there was no motility inward. The pupil was enlarged. There was temporal pallor and no bruit was noted. The swelling in the right eye was gradually reduced. Four months later, the eye appeared about the same; the vision, however, was much worse. The cornea was hazy. The patient was not seen again until four years later. The right eye was then shrunken into the orbit and was blind. The left eye presented temporal atrophy and complete temporal field defect. Two years later, the condition was unchanged.

A. KNAPP.

A CASE OF HYDATID CYST OF THE ORBIT. J. S. CHARAMIS, Arch. d'opht. **46:**362 (June) 1929.

The author points out that this condition is relatively rare, Grope having found only 1 case in 80,000. Teulieres had collected 141 cases up to 1927. Varnier in his thesis brought together 150. Since these two reports only two or three others had been found. The author reports a case the chief interest in which lies in the absence of pain. The classic triad of symptoms includes pain, tumor and exophthalmos.

S. B. MARLOW.

HYDATID CYST OF THE ORBIT. PERFORATION OF THE ORBIT AND ESCAPE OF THE CYST THROUGH THE NARES. B. ADAMANTIADÈS, Arch. d'opht. **46:**368 (June) 1929.

The case of a girl, aged 11, is reported. The chief symptoms were exophthalmos of the right eye and paralysis of the right internal rectus muscle. There was no pain and no tumor could be felt. At operation no tumor was found, but a probe liberated some yellowish pus and with it a perforation of the nasal wall of the orbit was found. A week after the operation while the patient was blowing her nose, a large piece of membrane came away. This proved on examination to be the wall of a hydatid cyst.

The author calls attention to the freedom from pain in his case and the possibility of its development after an examination. He could find only one other case in the literature in which the cyst was expelled through the nares.

S. B. MARLOW.

A PECULIAR FORM OF CALCIUM DEPOSIT IN THE EYE. V. MANDICEVSKI, Ztschr. f. Augenh. **68:** 221 (July) 1929.

A description of the deposit of lime salts in an eye enucleated from a patient, aged 20, serves as a basis for a general discussion of the chemical tests for calcium and the theories advanced for calcification in ocular tissues. From the distribution of the calcium deposits in the case in question, Mandicevski concludes that the process is that of absorption. The deposits have a fatty acid nucleus and are covered by a ferrous coating. They are probably formed from cellular suspensions found in the pathologic aqueous humor. The depositions are mainly in the lower portions of the anterior and posterior chambers and occur in the form of thin plates and needles.

A. M. YUDKIN.

Injuries

PATHOLOGIC EFFECTS OF ULTRAVIOLET RAYS ON EYE AND TREATMENT. E. G. LEAR, New York State J. Med. **29:** 1270 (Oct. 15) 1929.

Lear asserts that the ultraviolet rays are capable of producing a definite pathologic condition of the eye called "photo-ophthalmia." There is a definite period of latency between the time of exposure and the onset of the symptoms. A certain amount of these rays is capable of producing the pathologic condition in a one or liminal dose or in fractional or subliminal doses, the sum total of which should equal one continuous or liminal dose. The onset of the symptoms are first itching, then pain and photophobia. It is proved, clinically as well as experimentally, that the parts of the eye involved are the conjunctiva, cornea, iris and lens. Whether the retina, too, is affected by these rays is not with certainty established and remains to be determined by future observation and experiment. As regards the treatment, the ordinary treatment of conjunctivitis, such as the administration of silver nitrate or zinc sulphate, will aggravate the condition. The most gratifying effects are obtained from the immediate instillation of a suitable cycloplegic, preferably homatropine, with cold applications, and the wearing of smoked glasses against strong rays of light.

W. ZENTMAYER.

INJURIES TO THE EYE CAUSED BY THE OPERATIVE TREATMENT OF CHINESE QUACKS. ARNOLD PILLAT, Nat. M. J. China **15:** 525 (Oct.) 1929.

The writer, apparently a new-comer to China, was astonished at the frequency with which he found severe adhesions between the lid and bulbar conjunctiva, seen in Western countries only after severe burning by lime, alkali or acid solutions. Histories of burning were negative, and the trachoma was usually so mild that it could not be held responsible for the curious conditions. It was only after considerable

questioning that the condition was found due to operation by "acupuncture needles" by Chinese quacks. The latter acquire certain technic and experience. Frequently old women follow this work, and because of their presbyopia are especially dangerous. Details of four typical pictures of conditions caused by "needling" and by "excision of the conjunctiva" are given.

A man, aged 43, who had been suffering from an inflammation of the right eye for several weeks, had a "needling" which was followed by swelling, pain and marked inflammation. When first seen by the writer there was an inflammatory ptosis of the right eye, photophobia, epiphora and pain in the right side of the head. The cornea was slightly dim and showed a defect of the epithelium at the temporal margin under the covering conjunctiva. The whole bulbus was painful when touched. After fourteen days of local treatment, the eye quieted considerably, but after four weeks treatment the iritis had not totally disappeared. In this case there was undoubtedly a severe irritation of the right eye after "needling" performed in the region of the semilunar fold and in the temporal half of the bulbar conjunctiva. The operation caused an infection followed by disease of the cornea and the iris, so that in this case the treatment of a beginning mild unilateral trachoma by a quack led to ptosis, chemosis, corneal infiltration and iridocyclitis which could easily have caused loss of vision in the eye.

Three similar cases are reported, primarily to call the attention of ophthalmologists practicing in China, and of the Chinese public, who are occupied with questions of medicine and hygiene, to the severe injuries of the eye wrought by quacks, and to express surprise at the far-reaching operations on the eye which Chinese popular medicine still dares to do in contrast to popular practice in other countries.

The article is illustrated by six colored drawings, two photographs and one diagram of a face showing where "needling" should be performed.

S. H. McKee.

Some Injuries of the Eye Caused by Nonoperative and Operative Treatment of Chinese Quacks. Arnold Pillat, Nat. M. J. China **15:** 536 (Oct.) 1929.

This paper, as the title indicates, deals with the nonoperative treatment of Chinese popular medicines, and their consequences to the eye. The changes are, of course, not so severe as in the operative cases, and consequently not so easily recognized as those caused by operations. Not infrequently, one meets in China, patients with striking small white opacities either in the cornea, otherwise almost normal, or in an old thin pannus, where they stand in sharp contrast to the cleared-up opacities. These dots resemble closely, impregnations of the cornea after prolonged use of mild mercuric chloride. The details of a numbe of cases are given.

Case 1 is that of an army officer, aged 27, who had suffered from trachoma, and for a couple of years had used among other things a white Chinese powder. Examination showed an almost healed cicatricial trachoma, with a few linear scars in both upper lids. Slit-lamp examination showed that in addition to the superficial pannus opacities, and the distinct white spots previously mentioned, there was another distinct

layer of very fine, pannus-shaped opacities, just in front of Descemet's membrane. It was made up of numerous fine powder-like particles. These impregnations were also found in the superficial pannus opacity. In this case, the author was dealing with an impregnation of the cornea, caused by a powder obtained at a Chinese drug-store. The name of the powder is "pearl powder" used chiefly in the treatment for ulcers of the leg, but with the reputation of curing almost anything.

The article is illustrated by nine photographs.

S. H. McKee.

Sympathetic Ophthalmia

Sympathetic Ophthalmia. Morax, J. A. M. A. **93:** 1322 (Oct. 26) 1929.

Morax considered various aspects of the mysterious disorder termed "sympathetic ophthalmia." In agreement with Elschnig, he stated that it is due to a resorption of the uveal pigment, with sensitization of the other eye. Acting on this conception, Woods prepared pigment antigen, by means of which he established a veritable Bordet-Gengou reaction. Woods obtained also intradermal reactions with uveal pigmentary products. But careful investigation has shown that while most patients with sympathetic ophthalmia reacted to the blood or to the skin test, there were eyes that presented frankly the characteristics of sympathetic ophthalmia in spite of a negative reaction. As to the infection theory, it is probably well founded, although the microorganism or virus is unknown. The disorder has nothing in common with the experimental aspergillosis of Deutschmann; the latter corresponds possibly more to the infection by the herpetic virus of von Szily. Examination of eyes affected by sympathetic ophthalmia reveals the presence of collections of leukocytes throughout the uvea, but especially in the choroid.

W. Zentmayer.

Operations

A Modification of Lagrange's Operation. W. H. Kiep, Brit. M. J. **2:** 341 (Aug. 24) 1929.

The technical difficulty of the Lagrange operation and that the size of the scleral wound is out of all proportion to the needs of the case have suggested to the author the following modifications: A conjunctival flap made as thick as possible is reflected down to from 1.5 to 2 mm. from the limbus. A Tooke's corneal splitting knife then cuts a groove in the sclera at a distance of from 2 to 2.5 mm. from the limbus. This serves there for the application of the point of a keratome, and the keratome is pushed straight downward into the anterior chamber, the incision measuring from 3 to 4 mm. The keratome is rapidly withdrawn so as not to lose the aqueous. The anterior scleral lip is seized with the fine forceps, and a small piece excised with de Wecker's scissors. The peripheric iris is abscised, so making a small peripheric buttonhole iridectomy. The iris is replaced by pressing on the cornea at the limbus with a spatula. The conjunctival flap is secured by a stitch. The author sees these advantages in this modification:

1. There is minimum disturbance to the intra-ocular structures and risk of intra-ocular hemorrhage.

2. In most cases, the operation can be done without collapse of the anterior chamber.

3. The thickness of the conjunctival covering of the fistula safeguards against late infections.

4. Should fibrosis develop, the operation may be repeated.

A. KNAPP.

CONCERNING A CASE OF CONGENITAL PTOSIS, OPERATED BY A NEW METHOD. M. NIDA, Ann. d'ocul. **166:** 639 (Aug.) 1929.

The operations of de Wecker, Angelucci, Hess, Panas and Poulard were mentioned, also the methods of Motais and Parinaud.

The prinicpal of the operation of Nida consists in the attachment of the tendon of the superior rectus muscle to the superior border of the tarsus, without severing the connection of the former from the globe.

Local anesthesia of procaine hydrochloride 4 per cent plus a few drops of epinephrine was employed in the case reported. The lid was everted during the whole operation. The tendon of the superior rectus muscle was carefully dissected free, especially on the sides and the scleral surface, without detaching it. A transverse narrow flap was next dissected from the upper border of the tarsus, the temporal end remaining attached, while the nasal end was cut free. The tarsal flap was slid under the tendon, after a double armed suture was placed in the free end. It was sutured in its original position, after sliding it under the elevated superior rectus tendon.

The immediate and ultimate results were good. There were no corneal complications, diplopia or lagophthalmos.

H. W. SCARLETT.

General Disease

AN INQUIRY INTO THE ORIGIN OF THE ABNORMAL PIGMENTATION OF THE SKIN AND CONJUNCTIVA IN CASES OF KERATOMALACIA IN ADULTS. A. PILLAT and G. KING, Brit. J. Ophth. **13:**506 (Oct.) 1929.

One of the most striking symptoms of xerosis epithelialis conjunctivae and of keratomalacia of adults in China is the pigmentation of the conjunctiva. In certain cases there is also a dark staining of the skin. The pigmentation was present in from 70 to 80 per cent of all the cases of keratomalacia seen in Peiping in the spring of 1929, but in varying intensity.

In keratomalacia the pigmented area has a peculiar dark brown color which resembles "argyrosis" or that seen in bronze diabetes or in Addison's disease. The pigment itself seems to have the same hue in all cases. Even the slightest pigmentation of the conjunctiva is as dark in its individual points as in an advanced case; the greater number of pigment dots produces the darker color. The pigment lies chiefly in the basal cell layer of the epithelium and in the intercellular spaces, from which it advances into the middle layers and in some cases extends almost to the surface of the kerato-hyaline edges of the thickened epithelium. The pigment increases in intensity as long as the keratomalacia progresses and disappears in the process of healing but at a much slower rate than do the other clinical symptoms.

In order to determine the rôle the liver plays in the production of the conjunctival pigmentation the authors undertook special tests of liver function in a series of twelve cases of keratomalacia. Their investigation seems to show that it is improbable that any marked degree of impairment of the function of the liver is present in cases of keratomalacia, and that the pigmentation found in such cases is probably not of biliary origin.

W. ZENTMAYER.

CORNEAL EDEMA IN PATIENTS WITH HYPERCHOLESTERINEMIA. E. AUBINLAU, Ann. d'ocul. **166**:645 (Aug.) 1929.

A rare ocular symptom may exist in patients having an excess of cholesterin in the blood, namely, corneal edema, which is sometimes unilateral and sometimes bilateral. A report of this condition was first made by the author in the *Annales d' oculistique* in 1922, when he published the observations in three cases.

In this memorandum, five new observations are presented, showing a central area of edema in the cornea which caused a lowering of vision that became worse in the morning, with the results of physical and blood chemistry examinations. All the patients presented some gastro-intestinal derangement, with cholesterinemia. There was a complete absence of irritative symptoms or of hypertension, with entire integrity of the internal tissues of the eye; the field of vision was normal. Amelioration of the condition occurred after a proper dietary regimen was instituted.

H. W. SCARLETT.

A CASE OF QUINCKE'S EDEMA WITH BILATERAL HEMICONJUNCTIVAL HYPERMIA, AND A CASE OF HEMIURTICARIA. A. LUNEDEI, Riv. oto-neuro-oft. **6**: 289 (July-Aug.) 1929.

Lunedei has had the opportunity to observe and reproduce in colors a case of Quincke's edema with sharply defined bilateral vasodilatation or hyperemia of the external halves of the bulbar and palpebral conjunctiva. This picture was seen in a girl, aged 15, during one of a series of attacks of acute edema of the lids, the nose and the middle third of the face. Nasal breathing became difficult. The facial edema was of a pale rose color, shiny, hard, tense, elastic and without pruritus; pitting, even after prolonged and intense pressure, lasted only a few seconds. With the disappearance of the acute edema of the face, the conjunctival hyperemia vanished. It must be remembered that the edema of Quincke is deep-seated, differing thus from the edema of urticaria.

Rhinoscopic examinations of this patient, and also in a second case of urticaria involving the right half of the face and the entire left side of the body, were instructive. Lunedei found the same gray cyanotic patches of the nasal mucosa first described in 1923 by Wojatschek of Russia in cases of asthma, now called Wojatschek's sign. In spite of researches, nothing new has been discovered regarding the pathogenesis of this coincident sign. The nervous system seems to have been excluded as a factor in its genesis (Undritz).

Logically, it has been admitted, but it has never been satisfactorily ascertained and demonstrated, that the pathologic conditions known as

migraine, glaucoma, Ménière's disease, spasmodic coryza, pharyngitis sicca, Kobrak's syndrome and the hemorrhagic syndromes are disturbances of the capillaries. Wojatschek's sign occurs in a great many of these conditions.

Capillary control seems to be threefold, nervous, hormonic and local tissue regulation. Of these, local tissue regulation has been studied least, not by physiologists, but by clinicians. The morphologic aspects of the capillaries, their motility, caliber, permeability, tonicity, fragility, of their walls and the endocapillary pressure depend on those three great factors.

Now, if a torniquet is applied to an extremity, such as the arm, and its pressure regulated to maintain either a hyperemia or an ischemia, one may observe a stasis or cyanosis, the type, a reactive hyperemia after ischemia, vasoconstrictor and vasodilator phenomena, paresthesias, allergic and hemorrhagic manifestations. Lunedei advocates this simple method because its intensity is easily controlled by measured pressure. It is intended to ascertain and demonstrate the presence of fundamental or constitutional morbid capillary states in the pathologic conditions above mentioned, as well as the part local tissue products play. It is a practical, clinical and beside test.

The character of some of these phenomena of stasis (cyanosis, hyperemia) appears to depend, above all, on the ease of liberation or of accumulation, in the tissues, of acid metabolites (especially CO_2). Other phenomena of this capillary dilatation, such as the paresthesias and the allergic reactions of stasis, seem to depend, above all, on the liberation of histamine-like substances. Finally, hemorrhagic manifestations seem to depend on still other substances causing changes in capillary fragility e. g., morbus Schoenlein-Henoch). In order to fix this concept by a term, the author calls these disturbances in tissue regulation of capillary function, "tissue angiophilia." Greater detail of interpretation may be culled with profit from Lunedei's articles in the Rivista di clinica medica, 1929.

V. R. Syracuse.

Some Observations on the Ocular Complications of Dengue During the Last Epidemic in Greece. S. Charamis, Arch. d'opht. **46**:210 (April) 1929.

After first briefly referring to the etiology of Dengue and the work done at the Pasteur Institute of Athens the author enumerates the ocular symptoms observed. Two cases showed deep orbital pain and intense photophobia. In another case periorbital pain was referred along the fifth nerve. There were three cases with muscae, two cases of optic neuritis and several of ulcerative keratitis, one of which went on to perforation. Many cases of conjunctivitis occurred.

S. B. Marlow.

Society Transactions

EDITED BY DR. GEORGE S. DERBY

COLLEGE OF PHYSICIANS OF PHILADELPHIA, SECTION ON OPHTHALMOLOGY

A. G. FEWELL, M.D., *Secretary*

Meeting, Oct. 17, 1929

C. E. G. SHANNON, M.D., *Chairman*

SOME INTERESTING FUNDUS PICTURES. DR. ARTHUR J. BEDELL, Albany, N. Y.

Dr. Bedell exhibited a large number of photographs of fundi from his collection of more than 10,000. His demonstration was divided into two parts; (1) single pictures thrown on the screen, (2) stereoscopic photographs presented by means of the anaglyph method.

Among the notable single plates were examples of (1) drusen, (2) various types of retinochoroiditis, (3) angioid streaks, (4) partial optic atrophy in which the difference in color between the affected and unaffected portion of the nerve was clearly distinguished, (5) asteroid hyalitis and (6) disklike degeneration of the macula.

The stereoscopic presentation included several cases of tuberculosis, preretinal edema, rupture of the choroid, stages in the progress of thrombosis of the retinal vein, an advancing hypertension, optic neuritis and choked disk.

Dr. Bedell showed by serial photographs, the development of angiomatosis, the primary circumpapillary exudate and the dilated vessels. He gave illustrations of the massive exudate leading to the gross detachment of the retina and the irridescent perimacular crystals.

Seventy-five lantern slides made from his original plates were used to illustrate his talk.

THE CLINIC FOR THE TREATMENT OF OCULAR SYPHILIS AT WILLS HOSPITAL. DR. JOSEPH V. KLAUDER AND DR. HAROLD ROBERTSON.

Dr. Klauder and Dr. Robertson believe that knowledge of syphilis in its clinical, pathologic, laboratory and therapeutic aspects has greatly increased within recent years. The literature of the disease has become voluminous. The number of new therapeutic agents is increasing. Treatment is becoming more complex, so that the therapeutic management of syphilis has in a large measure, become the work of the specialist. The administration of so-called mixed treatment or mercury rubs, no longer constitutes, as it did years ago, the limit of therapeusis.

A physician undertaking the management of modern therapy of syphilis should be familiar with the following considerations: (1) the numerous preparations of arsenic, mercury, bismuth and other spirocheticidal drugs and therapeutic agents; (2) their clinical status; (3) their therapeutic index (ratio of therapeutic dose to lethal dose in syphilis experimentally produced in rabbits; (4) their mode of admin-

istration; (5) their toxicologic reactions and the contraindications to their employment; (6) what constitutes intensive treatment, its hazards, when to employ it and when it is contraindicated; (7) the hazard of treatment as compared with the hazard of the disease; (8) the time to carry out a formula of treatment; (9) the point at which to individualize and fit the treatment to the patient; (10) the dosage to employ, the interval between administration and the duration of treatment; (11) the indications for an examination of the spinal fluid; (12) the conditions which designate a patient as a proper candidate for marriage.

The physician must realize that it is not a positive Wassermann reaction that he is treating, but rather a patient with a systemic infection whose status is to be determined by clinical and laboratory examinations. He must have a comprehensive knowledge of the methods of laboratory and serologic diagnosis and the interpretation of positive and negative results. Such physician should be able to visualize syphilis as an infection from a pathologic and clinical point of view and should be familiar with the subjective and objective symptoms of syphilis of the various organs.

In view of the complexity of modern therapy, the importance of follow-up systems for proper treatment, familial studies of patients with congenital syphilis and the many ramifications of syphilis in clinical medicine, it has been deemed desirable at Willis Hospital to centralize the treatment of patients with syphilis in one department.

The primary motive in the treatment of patients with syphilitic lesions of the eye is not only the healing of the eye lesion, but the cure or arrest of general syphilitic infection of the eye.

The therapeutist should consider not only an inflamed cornea or uveal tract, but rather a patient with a systemic infection having an ocular manifestation. Accordingly, the treatment of lesions of the eye due to syphilis, should not consist simply of routine administration of antisyphilitic drugs. It is now necessary, by a complete examination, to determine the status of the syphilitic infection of the patient, to adopt a specific rather than a routine or formulated plan of treatment.

Different case records are employed for patients with congenital syphilis, neurosyphilis and marked general syphilis. These case records were exhibited. The history examinations of the eye and physical examinations of patients in the different stages of syphilis, were discussed. A diagrammatic outline of the clinic was shown, each phase of which was discussed.

Since interstitial keratitis is a phase of congenital syphilis, its proper study embraces familial studies. Case records on lantern slides showed instances of such familial studies. Interstitial keratitis as a manifestation of congenital syphilis was discussed. Its appearance after trauma and the incidence of Clutton's joints were particularly discussed.

Neurosyphilis is notably represented in patients having optic atrophy and oculomotor paralysis. Examination of these patients includes particularly neurologic and spinal fluid examinations and examinations to determine physical fitness for treatment, which is adopted to the patient in relation to the urgency of the case and the physical condition.

Case records on lantern slides were shown.

Patients with tertiary syphilis include those with uveitis, with pathologic changes in the fundi, those with preoperative Wassermann reactions and those with positive Wassermann reactions whose ocular lesion is nonsyphilitic or of doubtful syphilitic origin. In this group it is necessary to fit therapy to the patient.

Patients with secondary and late secondary syphilis are represented chiefly by patients with uveitis. Since these patients are usually below middle age, a standard formula of treatment is more likely to be carried out here than would be in any of the other groups.

Treatment for ocular syphilis was discussed in a general way. A standard formula of treatment suitable to all patients was not considered as appropriate. In the choice of antisyphilitic drug, dosage, interval of treatment, and conjoint treatment, the age of the patient, the urgency of the case and the physical condition of the patient, should be considered. The status of the different antisyphilitic drugs was discussed.

DISCUSSION

DR. GRISCOM: The aid which Dr. Klauder, through his department, has given in the treatment of patients with various forms of ocular syphilis is of great value. I wish to emphasize the fact that each patient demands individual study by the syphilologist in order that the most effective form of treatment may be used. Advances in the therapy of syphilis during the past fifteen years have been such that only one trained in this work is capable of selecting and applying one or more of the drugs now in use. This was well illustrated in Dr. Klauder's paper, by the reference to the absence of involvement of the second eye and recurrences in interstitial keratitis, under selective and intensive treatment. It is important that ophthalmologists recognize the possibilities of antisyphilitic therapy in this disease in which involvement of the second eye has by many been considered unavoidable.

DR. FUCHS: We have seen so many interesting cases tonight, showing the consequence which the unfortunate victims of congenital syphilis have to bear, that there is little that I can add. Years ago I came across another ocular symptom of hereditary syphilis which may be little known. I know I have seen only one paper which concerned it; this I believe was read at a meeting in Belfast. These patients with hereditary syphilis sometimes have vertically oval cornea. The patients whom we have just discussed, have vertical ellipsis and a higher degree of astigmatism. I do not hold that all cases of this type of astigmatism are syphilitic, but a great majority of them are.

What I would like to know is if any such cases have been observed in children during the first year of life. In a summary of this type it would be interesting to know if any of these patients have been observed developing during the first year, if so, it would contribute to the symptoms of inherited syphilis.

DR. ROBERTSON: I believe that a clinic of this type has a definite place if only for the treatment of patients with interstitial keratitis. For, as stated under this form of treatment, in a study of over 100 patients, recurrence had followed in only 6 per cent of the cases, which was a great decrease from the number in former years. It is also interesting to note that 52 per cent of all persons with congenital syphilis who are brought to medical attention, have, or have had interstitial keratitis;

only 22 per cent have normal vision. In children, this means many days' absence from school, long periods of photophobia and discomfort, and in many instances, mental disorganization for the rest of life.

It is interesting to note that interstitial keratitis leaves restricted or actually damaged vision; only 60 per cent of patients afflicted ultimately recover full vision. This is unfortunate when modern methods of treatment resulting from a clinic of this type bring such great relief to the patients having interstitial keratitis.

Dr. Warren S. Reese showed a case of drusen of both nerve heads. He called attention to the fact that this condition is consistent with normal vision when there are no other ocular complications.

ROYAL SOCIETY OF MEDICINE, SECTION OF OPHTHALMOLOGY

H. Dickinson, M.D., *Reporter*

Meeting, Nov. 8, 1929

Cyril Walker, F.R.C.S., *Chairman*

A Case of Hereditary Ptosis with Epicanthus. Miss Hamilton McIlroy.

Miss McIlroy stated that this condition was hereditary but was of rare occurrence; no cases of it had been published since Mr. Usher's in the 1926 volume of *Eugenics*. The patient was a girl, aged 13, who was seen by Miss McIlroy at a school clinic, and later at a hospital. The other members of the family had not yet been examined, but the girl's mother was said to be mentally defective; the father was too ill to be able to attend the hospital. There was well marked bilateral ptosis, with slight epicanthus, and the head was thrown back in the posture characteristic of ptosis; the eyes were kept open by the action of the occipitofrontalis muscle. Both nystagmus and divergent strabismus were present. Owing to the local condition and the subnormal mentality, the degree of refraction was difficult to estimate. Glasses had been prescribed, because of the considerable myopia. The best vision obtainable was 6/36. Since 1922 the patient had been at a school for myopic children. Her condition was never deemed bad enough for her to be sent to a school for mental defectives. A number of pedigree charts were projected on to the screen.

Special Instruments. Mr. Tudor Thomas.

Mr. Thomas showed a sterilizer for drop-bottles, and spectacles designed for a man who was rigid in a posture which placed the trunk almost at a right angle with his legs, so that it was with great difficulty that he could see more than people's feet when walking. The spectacles were prisms which had the face upward, the apex pointing to the ground. He could now see most of the sights as he passed along.

EPITHELIAL HYPERPLASIA OF THE CORNEA. MR. TUDOR THOMAS.

This condition followed irritation of the eyes by fuel dust; the patient was a fuel worker, aged 52. Three years before, dust had entered the right eye and had been followed by inflammation, and that condition had not since cleared up. The dust contained 6 per cent of pitch. There were three separate grayish white patches. They were slightly raised, and gave the appearance of gray-white keratinized material. In a month or two the growth was 7 mm. in extent, and two months ago the growth had been removed, a conjunctival flap being drawn over the raw area. Three weeks later a white patch commenced to form in the limbus, and in three weeks it had extended. The vision of that eye was 6/36. The growth was removed, but it started to recur. Microscopically, there was great thickening of the epithelium, and leukocytic infiltration at the base; there were also prickle cell nests.

DISCUSSION

MR. TREACHER COLLINS: I do not doubt that this was epithelioma of the cornea. It did not dip down into the deep tissues as quickly as does epithelioma of the skin, because of the dense character of the fibrous tissue underneath. The growth remained a long time confined to the surface. I excise down to the substantia propria, subsequently treating with radium. Some years ago I recorded a case which was treated in that way, only one application of radium having been made. I followed the patient for some years, and he died without any recurrence having taken place.

EXTREME ATROPHY OF CHOROID AND RETINA. MR. LESLIE PATON.

This case gave an almost diagrammatic picture of the grosser choroidal circulation. In a similar case which Mr. Paton showed two and one-half years ago there was a history of syphilis, and the latter might have been responsible for the atrophy of the choroid. In both those cases there was an acquired atrophy. In the first of the cases blindness came on at 7 or 8 years of age and had progressed steadily, so that now the patient was absolutely blind. The condition differed from those cases which were congenital.

LATTICEWORK KERATITIS. MR. J. D. CARDWELL.

With the aid of the slit lamp a small area of hyaline membrane could be seen on the back of the cornea. In association with the membrane there were patches of pigment, and pigment could also be seen on the rods of the latticework itself. In both eyes there were signs of old iritis, but the membrane was present only in the left eye.

RETINITIS IN DIABETIC PATIENTS. DR. P. J. CAMMIDGE.

This paper was founded on the last 1,000 of the author's cases of diabetes mellitus. Of these, forty-eight patients (or 4.8 per cent) suffered from retinitis and retinal hemorrhages as a complication. The percentage in Joslin's cases in America was 5.2, but van Noorden gave 17. Dr. Cammidge thought that the difference was due to the particular form of diabetes seen in the various countries. It should be remembered that the cardinal symptom of diabetes, i. e., glycosuria, might arise from

a variety of causes. It could be divided into two main varieties: (1) the anapothetic, or alimentary, in which there was difficulty in the storage of carbohydrates, and (2) the achriatic, in which there was deficiency utilization as well as defective storage. As a rule, the former kind was found in elderly persons and the latter before middle age. Retinitis was generally associated with the first of these forms. In 40 per cent of the cases of retinitis there was a history of diabetes in immediate relatives. It was now regarded as doubtful whether a retinitis due to diabetes alone ever occurred. Moreover, there was not that relation between the severity of the diabetes and the incidence of the retinitis which would be expected if the retinitis was the direct result of the metabolic disturbances consequent on the primary disease. In these patients there was a calcium deficiency in the blood, and the resulting diminished coagulability of the blood was one of the factors in the production of those locally recurring hemorrhages which were of such grave prognostic significance. In these cases the systolic pressure was usually 150 mm. or more. Many patients improved rapidly in vision when the hyperglycemia and the glycosuria were controlled by treatment. The edema was probably the result of alterations in the osmotic pressure in the tissues, caused by the presence of an excess of sugar in the blood. An accurate differentiation of the various types could be made only by chemical analysis of the blood under test conditions; that enabled one to estimate the functional efficiency of the kidneys.

In giving insulin, it was important to commence with small doses, i. e., one should avoid a sudden reduction of the blood sugar. The author had found that 5 grains (0.32 Gm.) of calcium lactate daily sufficed to maintain the percentage of calcium in the blood within the normal range and prevent further hemorrhages. Dr. Cammidge had been experimenting with both parathyroid and vitamin D, but his experience with them was not sufficient to enable conclusions to be drawn.

Finally, he said that the administration of lime salts by mouth in sufficient quantity to maintain the percentage of calcium in the blood at the normal level prevented local hemorrhages in diabetes retinitis.

DISCUSSION

DR. R. D. LAWRENCE: I came because I wanted to learn something about the mystery of the causation of diabetes retinitis. About 11 per cent of my diabetic patients under treatment have retinitis, diagnosed as such by ophthalmic surgeons.

What are the real factors that cause these hemorrhages and exudates? Many people deny that there is a diabetic retinitis apart from arteriosclerosis; but I think that this is laying too much emphasis on the vascular side. All these patients had high blood pressure and albuminuria. I have a suggestion to offer in regard to the cases which did not show any ordinary arteriosclerosis; namely, that the real injury is that which was caused to the endothelium of the vessels. Another factor in the production of exudates and hemorrhages is change in osmosis caused by the hypoglycemia. These are the cause of cataract in diabetes. Since the introduction of insulin a swelling of the lens has occurred, and 40 per cent of the severe cases which I treat show misty vision for the first few days or hours while the blood sugar is being reduced to normal.

LIEUT. COL. A. E. J. LISTER: In what proportion of the cases has the retinitis cleared up? How was the calcium given, and in what quantity? In India the proportion of diabetic patients having retinitis is higher than Dr. Cammidge gave. Also in that country the age period of incidence is somewhat earlier, though that may be because people age quicker in India than in Europe.

DR. P. J. CAMMIDGE: I included as cases of retinitis only those in which the condition was diagnosed by an ophthalmologist. Perhaps it is because I took only typical cases that the figure is low. I agree with Dr. Lawrence that sugar alone is not answerable, but I think that the actual retinitis, the edema and so on, which interferes with vision, is due to sugar, because these cases clear up so rapidly when treated, especially now that insulin is available.

With regard to treatment, these patients are usually elderly or very old, and I have a strong objection to using insulin for them, as it is unwise to reduce quickly the amount of sugar in the blood. If these elderly diabetic patients are treated by dieting, they are much more comfortable, and they do well, though the process may be longer than with insulin. It is my practice to make a routine estimation of the calcium in the blood, as well as of the sugar. I give calcium lactate, 5 grains (0.32 Gm.) three times a day in a paraffin emulsion, and perhaps increase it to 7 grains (0.46 Gm.). It is a prophylactic measure and must be continued throughout the subsequent life.

SARCOMA OF THE IRIS. MR. TUDOR THOMAS AND MR. M. S. MAYOU.

Mr. Mayou at first thought, from the clinical appearance, that this was a cyst, especially as it seemed to transilluminate well, but his colleague turned out to be correct when he diagnosed sarcoma. The growth was situated in the angle of the chamber, and was spreading forward along the surface of the iris. It was later commencing to invade the ciliary body.

SARCOMA ON THE OUTER SIDE OF THE HORIZONTAL MERIDIAN OF THE IRIS. MR. M. S. MAYOU.

The growth presented a heaped-up convoluted appearance on the surface. Vision was 6/6. The cells were of the big spindle type, such as is seen in moles and pigmented nevi. These masses of pigment were scattered through the tumor.

A CASE OF LEUKOSARCOMA OF THE IRIS. MR. P. STALLARD.

Mr. Stallard showed pictures of this condition in a man, aged 69. The tumor was removed. It consisted of spindle shaped cells having an oval nucleus. There was a marked absence of intercellular stroma. The patient was persuaded to have his eye removed, but no other abnormality was discovered.

Book Reviews

THE PATHOLOGY OF THE EYE. By JONAS S. FRIEDENWALD, A.M., M.D., F.A.C.S. Price, $4.50. Pp. 346, with 253 illustrations. New York: The Macmillan Company, 1929.

This book is an elaboration of lectures prepared for the instruction of medical students and surgical house officers in the department of ophthalmology of Johns Hopkins University Medical School and Hospital. It is by no means a complete pathology. It aims merely "to form a bridge leading from general pathology to this special pathology."

There are fifteen chapters, with a handy appendix on microscopic technic.

In the introductory chapter, the anatomy and function of the different parts of the eye are considered so far as they relate to pathologic processes. One is reminded of the difficulty encountered in attempting to give histologic interpretations of ophthalmologic observations. Ophthalmologists are accustomed to see tissues in two ways, either with the naked eye or under the microscope at 100 or more magnifications. With the ophthalmoscope, one sees the fundus under a magnification of about 15 diameters, producing a picture different from that seen with the naked eye or with the microscope.

The second chapter is devoted to inflammatory lesions involving the eyeball as a whole. Starting with panophthalmitis, the author observes that the reactions of the eye to inflammatory agents tend to a certain uniformity without much regard to the particular site at which the damaging agent makes its first appearance. He applies the term panophthalmitis with a view to the inflammatory reaction rather than to that of the inflammatory agent. He recognizes two types of panophthalmitis: the acute or purulent form and the subacute form, or rather that form which from the beginning is subacute.

The third chapter deals with focal lesions, of which two general types are distinguished—those resulting from specific infections, such as syphilis and tuberculosis, "and those far more numerous cases of unknown etiology which present clinically and pathologically a nonspecific and nondescript picture."

Instructive are the author's original observations on ocular lesions in fetal syphilis. In a small number of these cases there is a diffuse infiltration of the choroid, and sometimes of the retina and optic nerve, with wandering cells of the myeloid type. The lesion in the choroid leads to a widespread interstitial scarring, in contradistinction to the circumscribed scars resulting from syphilitic manifestations later in life. The seat of the most extensive scarring is in the internal layers of the choroid, impairing the nutrition of the pigment epithelium and of the rods and cones. At some points the pigment cells atrophy; at others they proliferate. The characteristic peppery appearance of the eye-ground results.

In the chapter on cataract the author advances the theory that the lens depends for its nutrition on the permeability of its capsule. He is convinced that the decrease of this permeability which takes place

with age is sufficient to initiate the development of the ordinary senile cataract.

In the consideration of glaucoma, the writer believes that primary acute glaucoma is the result of a local vasomotor crisis manifesting itself in an increased permeability of the capillaries of the ciliary processes, which become engorged and surrounded by concentric rings of fibrin. The escape of serum into the vitreous and anterior chamber can be demonstrated. With the swelling of the ciliary processes, the root of the iris is pushed forward against the back of the cornea, while the concomitant relaxation of the zonular fibers is associated with a slight dislocation of the lens.

The chapter on senile changes and arteriosclerosis is a valuable contribution. It is pointed out that while in other organs sclerosis of the small veins of the order of those of the retina is extremely rare, in the retina venous sclerosis is quite common. From his own study the author concludes that the cause is to be found in the fact that the walls of the arteries and veins are fused together in the retina at points where these vessels cross one another. In retinal arteriosclerosis an extension of the lesion in the arterial wall may often be traced to the vein at points of crossing. The phenomenon of arteriovenous compression is to be attributed not to the dynamic pressure of an artery, with increased arterial pressure, on the adjoining vein, but to an actual encroachment of the thickened arterial and venous walls on the common space within the common arteriovenous fibrous coat at the point of crossing.

The illustrations of the book, which are original, make a valuable atlas of the histopathology of the eye. They are photomicrographs of preparations from the collections of the Wilmer Ophthalmological Institute and the Army Medical Museum. Miss Helenor Campbell, who provided the illustrations, deserves great praise.

With painstaking care text references are given at the end of every chapter but one.

This volume is not dry pathology. I have read it with interest, profit and admiration. The author's comments and original observations are keen and refreshing. There are so many good features that it would be paltry for the reviewer to find fault with details.

BERNARD SAMUELS.

THE ADAPTATION OF THE EYE: ITS RELATION TO THE CRITICAL FREQUENCY OF FLICKER. By R. J. LYTHGOE and K. TANSLEY. Report of the Committee on the Physiology of Vision. Price, 2 shillings, 6 pence. Pp. 72. London: His Majesty's Stationery Office, 1929.

This is a report of a series of tests made on six persons, over a period of several months, with the aid of a photometer measuring the critical frequency of flicker. The apparatus consists essentially of a disk with a sector cut out, rotating in front of a light source until the flickering impression gives way to a sensation of continuous light. This method has been employed to determine the brightness of different parts of the spectrum, and has been used by a number of observers to test the behavior of the eye under different states of adaptation. The critical frequency is expressed in flashes per second; the expression "a rise in

critical frequency" means an increase in the number of flashes per second necessary to produce fusion.

The subject is seated inside a cube with white walls measuring 152 cm., on which were several fixation points making angles of from 10 to 105 degrees, with the line between the test patch and the eye. The light from the flicker apparatus plays on a patch visible through a square window subtending 1 degree at the subject's eye.

Measurements were made during the course of dark adaptation; in the almost completely dark adapted eye, and also during the course of light adaptation. It was found that the results of the tests were in good agreement with the performance of the eye under other visual tests.

As a result of the experiments the observers have drawn the following conclusions: (*a*) That the critical frequency due to the cones falls during dark adaptation and with decreasing levels of light adaptation, and is highest when the brightness of the test patch and the surrounds are equal. (*b*) That the critical frequency due to the rods rises during dark adaptation and with decreasing levels of light adaptation, and is highest with completely dark surrounds. (*c*) That the peripheral cones are not identical with foveal cones.

The work of these observers is extremely valuable because of the extraordinary care taken to eliminate all sources of error in the apparatus, which is described in great detail and the results are shown by many tables and charts.

J. B. LYNCH.

KRIEGSBLINDENSCHULE GEHEIMRAT SILEX. By H. HIRSCH, Directress of School, Berlin, 1914-1929. Pp. 38, with illustrations.

The introductory remarks are written by Dr. Geib, Secretary of the Government Labor Bureau.

The preface praises the keen interest and the devoted labor of Professor Dr. Paul Silex, for whom the school was named.

The text deals briefly with the development of the school; it describes in detail the methods of instruction and the patients' reactions; it also discusses the difficulties in selecting suitable occupations for these workers, and finally it refers to the continued work among the blind civilians who have been entering from time to time.

A statistical table shows that 761 blind persons were trained for twenty-four different vocations, many in which the blind hitherto had rarely been trained.

The report ends with testimonial letters of the efficiency of the blind trained in this institution.

This report is of primary interest to teachers of the blind and to institutions for the training of the blind, and is especially recommended to those giving instruction in schools for the blind.

JOHN H. OHLY.

Directory of Ophthalmologic and Otolaryngologic Societies *

FOREIGN

Oxford Ophthalmological Congress

Master: Dr. A. B. Cridland, Salisbury House, Chapel Ash, Wolverhampton, England.
Secretary: Dr. C. G. Russ-Wood, 12 St. John's Hill, Shrewsbury, England.
Time: July 10, 11 and 12, 1930.

NATIONAL

American Medical Association, Section on Ophthalmology

Chairman: Dr. T. B. Holloway, 1819 Chestnut St., Philadelphia.
Secretary: Dr. William C. Finnoff, Imperial Bldg., Denver.
Place: Detroit. Time: June 23-27, 1930.

American Academy of Ophthalmology and Oto-Laryngology

President: Dr. William H. Wilder, 122 S. Michigan Ave., Chicago.
President-Elect: Dr. J. F. Barnhill, Miami Beach, Florida.
Executive Secretary: Dr. William P. Wherry, Medical Arts Bldg., Omaha.
Place: Chicago. Time: October, 1930.

American Ophthalmological Society

President: Dr. W. Campbell Posey, Radnor, Pa.
Secretary: Dr. Emory Hill, 501 E. Franklin St., Richmond, Va.
Place: Hot Springs, Va. Time: June 2, 3 and 4, 1930.

LOCAL

Los Angeles County Medical Society, Section on Ophthalmology and Otolaryngology

President: Dr. A. Ray Irvine, 727 W. 7th St., Los Angeles.
Secretary-Treasurer: Dr. J. Frank Friesen, 727 W. 7th St., Los Angeles.
Place: California Lutheran Hospital, Assembly Room. Time: 8 p. m., first Monday of each month.

Colorado Ophthalmological Society

President: A presiding officer is selected for each meeting alternately until all members have served.
Secretary: Dr. Donald H. O'Rourke, 217 Imperial Bldg., Denver.
Place: First floor, Metropolitan Building, Denver. Time: 7:30 p. m., third Saturday of the month, October to April, inclusive.

Medical Society of the District of Columbia, Section of Ophthalmology and Oto-Laryngology

Chairman: Dr. Louis S. Greene, 1710 Rhode Island Ave. N. W., Washington.
Secretary: Dr. E. R. Gookin, Medical Science Bldg., Washington.
Place: 1718 M St. N. W. Time: 8 p. m., third Friday of each month.

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* Secretaries of societies are requested to furnish the information necessary to make this list complete and to keep it up to date.

ATLANTA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. H. F. McDuffie, 45 Edgewood Ave., Atlanta, Ga.
Secretary: Dr. Leon E. Brawner, 157 Forrest Ave. N. E., Atlanta, Ga.
Place: Academy of Medicine, 38 Prescott St. N. E. Time: 8 p. m., last Thursday of each month.

EYE, EAR, NOSE AND THROAT CLUB OF GEORGIA

President: Dr. George B. Smith, Rome.
Secretary-Treasurer: Dr. William O. Martin, Jr., 384 Peachtree St., Atlanta.

THE CHICAGO OPHTHALMOLOGICAL SOCIETY

President: Dr. Charles G. Darling, 30 N. Michigan Ave., Chicago.
Secretary: Dr. Richard C. Gamble, 30 N. Michigan Ave., Chicago.
Place: Medical and Dental Arts Club. Time: Third Monday from October to May.

INDIANA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. H. A. Van Osdol, 320 N. Meridian St., Indianapolis.
Secretary: Dr. Robert J. Masters, 23 E. Ohio St., Indianapolis.
Place: Indianapolis. Time: December 10 and 11, 1930.

INDIANAPOLIS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. Robert J. Masters, Hume-Mansur Bldg., Indianapolis.
Secretary: Dr. Kenneth L. Craft, Hume-Mansur Bldg., Indianapolis.
Place: University Club. Time: 6:30 p. m., second Thursday of each month from October to May.

NEW ORLEANS OPHTHALMOLOGICAL AND OTOLOGICAL SOCIETY

President: Dr. W. A. Wagner, Pere Marquette Bldg., New Orleans.
Secretary-Treasurer: Dr. M. F. Meyer, Canal Bank Bldg., New Orleans.
Place: Eye, Ear, Nose and Throat Hospital. Time: Third Thursday of each month October to June.

BALTIMORE MEDICAL SOCIETY, SECTION ON OPHTHALMOLOGY

Chairman: Dr. Leo J. Goldbach, 1012 N. Charles St., Baltimore.
Secretary: Dr. Angus Lloyd MacLean, Johns Hopkins Hospital, Baltimore.
Place: Medical and Chirurgical Faculty, 1211 Cathedral St. Time: 8:30 p. m., fourth Thursday of each month from October to May.

NEW ENGLAND OPHTHALMOLOGICAL SOCIETY

President: Dr. S. Judd Beach, 704 Congress St., Portland, Maine.
Secretary-Treasurer: Dr. E. B. Dunphy, 520 Commonwealth Ave., Boston.
Place: Massachusetts Eye and Ear Infirmary, 243 Charles St., Boston. Time: 8 p. m., third Tuesday of each month from November to April, inclusive.

DETROIT OPHTHALMOLOGICAL CLUB

Chairman: Members rotate alphabetically.
Secretary: Dr. Parker Heath, David Whitney Bldg., Detroit.
Time: 6:30 p. m., first Wednesday of each month.

THE MINNESOTA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. C. N. Spratt, 900 Nicollet Ave., Minneapolis.
Secretary-Treasurer: Dr. J. H. Morse, 80 S. 7th St., Minneapolis.

Kansas City Society of Ophthalmology and Otolaryngology

President: Dr. L. R. Forgrave, Logan Bldg., St. Joseph, Mo.
Secretary: Dr. A. E. Eubank, Argyle Bldg., Kansas City, Mo.
Time: Third Thursday of each month from September to May. The November, January and March meetings are devoted to clinical work.

St. Louis Ophthalmic Society

President: Dr. Charles W. Tooker, 308 N. 6th St., St. Louis.
Secretary: Dr. Carl T. Eber, 1006 Carleton Bldg., St. Louis.
Place: St. Louis or Washington University Cafeteria.
Time: 6:30 p. m., fourth Friday of each month from October to April, inclusive.

Omaha and Council Bluffs Ophthalmological and Otolaryngological Society

President: Dr. Charles M. Swab, Medical Arts Bldg., Omaha.
Secretary-Treasurer: Dr. J. C. Davis, 1615 Howard St., Omaha.
Place: Medical Tea Room. Time: 5:15 and 7:00 p. m., third Wednesday of each month from October to May.

Academy of Medicine of Northern New Jersey, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Frederick J. Wort, 1080 Broad St., Newark.
Secretary: Dr. Earl LeRoy Wood, 31 Lincoln Park, Newark.
Place: 91 Lincoln Park South. Time: 8:45 p. m., second Monday of each month.

Brooklyn Ophthalmological Society

President: Dr. Robert M. Rogers, 680 St. John's Pl., Brooklyn.
Secretary: Dr. William F. C. Steinbugler, 515 Ocean Ave., Brooklyn.
Place: Kings County Medical Society Bldg., 1313 Bedford Ave. Time: Third Thursday of February, April, May, October and December.

Eastern New York Eye, Ear, Nose and Throat Association

President: Dr. John P. O'Keefe, 251 State St., Albany.
Secretary-Treasurer: Dr. Arthur F. Holding, 142 Washington Ave., Albany.
Time: Third Wednesday of October, November, March, April, May and June.

Buffalo Ophthalmologic Club

President: Dr. E. E. Blaauw, 190 Ashland Ave., Buffalo.
Secretary-Treasurer: Dr. A. F. Luhr, Medical Arts Bldg., Buffalo.

New York Academy of Medicine, Section of Ophthalmology

Chairman: Dr. E. F. Krug, 12 W. 44th St., New York.
Secretary: Dr. William F. C. Steinbugler, 815 Park Ave., New York.
Time: 8:30 p. m., third Monday of every month from October to May, inclusive.

Rochester Eye, Ear, Nose and Throat Society

Chairman: Dr. A. Vincent Walker, 833 South Ave., Rochester, N. Y.
Secretary-Treasurer: Dr. John F. Gipner, 53 Fitzhugh St., Rochester, N. Y.
Place: Rochester Medical Assn., 113 Prince St. Time: 8 p. m., third Monday of each month from October to May.

Syracuse Eye, Ear, Nose and Throat Society

President: Dr. George H. Rockwell, Physicians Bldg., Syracuse, N. Y.
Secretary-Treasurer: Dr. A. Harry Rubenstein, Medical Arts Bldg., Syracuse, N. Y.
Place: University Club. Time: Second Friday of each month except June, July and August.

NORTH DAKOTA ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. George M. Constans, Bismarck.
Secretary-Treasurer: Dr. F. L. Wicks, Valley City.

CLEVELAND ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

Chairman: Dr. M. Paul Motto, Rose Bldg., Cleveland.
Secretary: Dr. A. D. Ruedemans, Euclid and E. 93d St., Cleveland.
Place: Winton Hotel. Time: Fourth Friday of each month.

CLEVELAND OPHTHALMOLOGICAL CLUB

Chairman: Dr. W. E. Bruner, Guardian Bldg., Cleveland.
Secretary: Dr. M. P. Motto, Rose Bldg., Cleveland.

OREGON ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. J. W. McCollom, 346½ Washington St., Portland.
Secretary-Treasurer: Dr. Andrew J. Browning, 418 Mayer Bldg., Portland.
Place: Good Samaritan Hospital. Time: Third Tuesday of each month.

THE PITTSBURGH OPHTHALMOLOGICAL SOCIETY

President: Dr. Edward B. Heckel, Jenkins Arcade Bldg., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: Pittsburgh Academy of Medicine Bldg. Time: Fourth Monday of each month, except June, July, August and September.

THE PITTSBURGH SLIT-LAMP SOCIETY

President: Dr. W. W. Blair, 121 University Pl., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: 121 University Pl. Time: Second Monday evening of every month, except June, July, August and September.

PACIFIC COAST OTO-OPHTHALMOLOGICAL SOCIETY

President: Dr. Arthur Jones, 105 N. 8th St., Boise, Idaho.
Secretary-Treasurer: Dr. Walter F. Hoffman, 817 Summit Ave., Seattle.

COLLEGE OF PHYSICIANS, PHILADELPHIA, SECTION ON OPHTHALMOLOGY

Chairman: Dr. Maxwell Langdon, 1530 Locust St., Philadelphia.
Clerk: Dr. Alexander G. Fewell, 1924 Pine St., Philadelphia.
Time: Third Thursday of every month from October to April, inclusive.

THE RHODE ISLAND OPHTHALMOLOGICAL AND OTOLOGICAL SOCIETY

President: Dr. J. E. Raia, 276 Broadway, Providence, R. I.
Secretary: Dr. F. W. Dimmitt, 195 Thayer St., Providence, R. I.
Place: Rhode Island Medical Library. Time: 8:30 p. m., second Thursday in October, December, February and April.

SOUTHERN MEDICAL ASSOCIATION, SECTION ON EYE, EAR, NOSE AND THROAT

Chairman: Dr. Fred Hasty, 119 Seventh Ave., Nashville, Tenn.
Secretary: Dr. Fletcher D. Woodward, Box 162, University, Va.
Place: Louisville, Ky. Time: November, 1930.

THE MEMPHIS SOCIETY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

Chairman: Each member, in alphabetical order.
Secretary: Dr. R. O. Rychener, Exchange Bldg., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

Nashville Academy of Ophthalmology and Otolaryngology

Chairman: Dr. R. J. Warner, 706 Church St., Nashville, Tenn.
Secretary-Treasurer: Dr. W. W. Wilkerson, Jr., Bennie-Dillon Bldg., Nashville, Tenn.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month.

Dallas Academy of Ophthalmology and Oto-Laryngology

President: Dr. D. L. Bettison, Medical Arts Bldg., Dallas, Texas.
Executive Secretary: Dr. W. Mood Knowles, Medical Arts Bldg., Dallas, Texas.
Recording Secretary: Dr. L. A. Nelson, 4105 Live Oak, Dallas, Texas.
Place: Dallas Athletic Club. Time: 6 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

Fort Worth Eye, Ear, Nose and Throat Society

President: Dr. W. R. Thompson, 510 Main St., Fort Worth, Texas.
Secretary-Treasurer: Dr. R. H. Needham, Fort Worth National Bank Bldg., Fort Worth, Texas.
Place: University Club. Time: 6:30 p. m., first Friday of each month except July and August.

Houston Academy of Medicine, Eye, Ear, Nose and Throat Section

President: Dr. John H. Foster, 1300 Walker Ave., Houston, Texas.
Secretary: Dr. Edward W. Griffey, Houston Clinic, Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., first Thursday of each month from September to June.

The San Antonio Ophthalmolo-Oto-Laryngological Society

President: Dr. F. W. Sorrell, Gibbs Bldg., San Antonio, Texas.
Secretary-Treasurer: Dr. A. F. Clark, 728 Main Avenue, San Antonio, Texas.
Place: Bexar County Medical Library. Time: 8 p. m., first Tuesday of each month from October to May.

Puget Sound Academy of Ophthalmology and Oto-Laryngology

President: Dr. Will Otto Bell, Medical-Dental Bldg., Seattle.
Secretary-Treasurer: Dr. Francis A. Brugman, Medical-Dental Bldg., Seattle.
Time: 8 p. m., third Tuesday of each month, except July and August.

Utah Ophthalmological Society

President: Dr. F. M. McHugh, 17 Exchange Pl., Salt Lake City.
Secretary-Treasurer: Dr. H. Leroy Smith, Ezra Thompson Bldg., Salt Lake City.

Virginia Society of Oto-Laryngology and Ophthalmology

President: Dr. H. B. Stone, 303 1st St., S. W., Roanoke.
Secretary-Treasurer: Dr. Fletcher D. Woodward, Box 162, University.

Spokane Academy of Ophthalmology and Otolaryngology

President: Dr. O. M. Rott, Paulsen Bldg., Spokane, Wash.
Secretary: Dr. C. A. Veasey, Jr., 421 Riverside Ave., Spokane, Wash.

The Milwaukee Oto-Ophthalmic Society

President: Dr. Edward R. Ryan, 425 E. Water St., Milwaukee.
Secretary-Treasurer: Dr. O. P. Schoofs, 120 E. Wisconsin Ave., Milwaukee.
Place: University Club. Time: 6:30 p. m., third Tuesday of each month.